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The Department of Glass Technology, Sheffield, England

By Prof. W. E. S. Turner

At the invitation of the editor of THE GLASS INDUSTRY I have pleasure in giving some brief account of the Department of Glass Technology at Sheffield, England, and some idea of what we are attempting to do.

The photographs which accompany these notes show that the premises in which we are at present located are actually

Two-Pot Recuperative Furnace Showing Recuperators and Convertors for Oil Firing.

works premises. Before we entered them in 1921, they were occupied by a glass bottle company. Although it had been our original intention to develop and extend the small buildings specially erected for us previously, adjacent to the main university buildings, we were unable to do so because of the Rent Restrictions Act which was in operation, the site being partly covered with house property. The bottle works becoming vacant provided us with an opportunity of acquiring more space.

To obtain laboratories meant adapting buildings not originally intended for the purpose, but very fortunately a long two-storied warehouse was so substantially built and capable of ready modification, that we have obtained what is immediately necessary, without very great expense.

Two glass houses were in existence, an old one and a modern one. From its location the old and dilapidated glass house was more convenient to use than the more modern one, its main advantage, however, being that it already had a high level floor, under which recuperators for furnaces and other sub-structures could be built, whereas the new building was not so provided, and the cost of laying one was prohibitive.

We accordingly have at our disposal, not only laboratories, chemical and physical, library and various auxiliary rooms, but also a glass house equipped with experimental plant and capable of melting quantities of glass from about 1 pound to 1,000 pounds in weight. The small furnaces taking either crucibles or small glass house pots up to about 100 pounds' capacity, are fired by town's gas and compressed air, while the large recuperative furnace accommodating two pots each of about 1,000 pounds' capacity is fired by an oil system in which the burners fire vertically upwards through the eye. Other premises include clay working and pot making rooms, a store house and batch mixing sections, machine shop, compressor house and smith's shop.

It is, therefore, possible for us not only to carry out all kinds of chemical and physical researches, but also to prepare the necessary glass in considerable quantity if necessary. Students, therefore, have the opportunity of witnessing operations on something more than the laboratory scale, whilst research workers can obtain their requirements on the spot.

Courses of instruction leading to a degree are of at least three years' duration, a fourth year being necessary if the student wishes to graduate with honors. Opportunities for research are then available for those students who wish to proceed to the higher degrees of M.Sc., Ph.D., or D.Sc., and these degrees are open to graduates of other universities. In addition to the teaching work and general research work the department is also a center to which manufacturers come for assistance. A great deal of help is given to manufacturers, and the scale of the experimental plant available makes such assistance of real value. Plant views appear on the next page.

The Department of Glass Technology, Sheffield, England

Glimpses of the Experimental Plant

Inside the Glass House. Beginning the Operation of Experimental Tube Drawing.

The Glass House. Two Pot Recuperative Furnace and Pot Arch.

Portion of the Pot Making Room.

Batch Storage Room Showing Small Bins.

Part of Library.

General View of Plant

Opaque and Colored Glasses and Ceramic Glazes of the Same Nature*

By Albert Granger, D.Sc.†

(Translated by Donald Robertson, B.Sc. Tech.)

The first chemists who studied glass looked on it as a substance of definite composition. Dumas, in his chemical researches, drew the conclusion that glass was a mixture of silicates, and later Benrath, basing his observations on the fact that the silica in glass normally bears a molecular relationship to the bases of three to one, thought that glass consisted of trisilicates. Another chemist, Zulkowski, actually proposed fully developed formulæ to satisfy the chemical constitution of glass.

This conception of glass from a uniquely chemical point of view, whilst rendering certain incontestable services, led, on the other hand, to erroneous interpretations of certain phenomena, and hindered things from being viewed in their proper light.

From the time when the idea of a solid solution made its appearance another conception of glass could be visualized.

I think that many of the phenomena that can be observed in the preparation of vitreous bodies should be visualized with other eyes than those of a simple chemist, if a plausible explanation for them is to be found.

In examining from an impartial point of view the glasses manufactured in the industry, and those glasses rather more specialized, utilized under the general name of glazes, appertaining to the ceramic industry, one is obliged to recognize that there are often two methods of perception by means of which the explanation of a phenomenon can be sought. These two explanations, furthermore, may sometimes become invalidated in practice.

When seeking an explanation of the phenomena occurring during the opalization of glasses, one is led to suppose that at a certain stage an insoluble body is produced, which remains in suspension in the vitreous liquid. On pushing the reaction further, one may finally obtain a glass which is completely opaque.

Among the opacifying agents, the fluorides, fluorspar, and cryolite play an important part. With a certain charge, predetermined for a given glass, one may obtain an opaque glass on first pouring, but with a smaller quantity the same opacification is only obtained on reheating the glass.

The first explanations given to account for this phenomenon are widely different. There were chemists who would see in it a complicated chemical process. There had to be a reaction between the silica and fluorine with the formation of silicon fluoride; but, even then, how should this reaction produce opacity?

The following reactions were visualized successively:

(*a*) Formation of alumina without fluorine in a crystalline state in the glass.

(*b*) Formation of a sodium fluorsilicate with or without alumina.

(*c*) Formation of aluminium fluoride.

(*d*) Formation of occluded silicon fluoride.

(*e*) Formation of silica in a finely divided state.

(*f*) Separation of an earthly or alkaline-earthly fluoride on cooling.

Of these hypotheses, the separation of silica or alumina appears to be the most tenable.

This hypothesis does not require the production of silicon fluoride, although this product is obtained during the fusion of the glass; at the same time, one has the right to ask oneself if this production is not of a secondary character. The action of steam (coming principally from the hydrated materials of the batch) or the furnace gases, acting on the fluoride, produce hydrofluoric acid, which reacts at the same time on the silica. It seems to the author that this phenomenon of opacification by fluor-products is not entirely the main cause of the possible disengagement of silicon fluoride. I consider this reaction as secondary.

In 1915, G. Smull, taking up this subject of study, drew analogous conclusions; he regarded opacification as the separation from solution of silica or alumina.[1] It is difficult at the moment to justify this assertion, but it seems to me to be without question that the opacification should be the result of a separation of solid material disseminated throughout the mass.

On preparing a glass containing only a very small amount of fluorine, one may obtain, with a good melt, a light amber glass. This glass, on being lightly reheated, becomes opacified, but on repeating this treatment of the sample it again becomes clear. An explanation of this has been sought for in declaring that a fluoride of sodium has been formed during the period of heating, and that there has been a return to the state of calcium fluoride on cooling.

I do not believe in the truth of this explanation, because it is in contradiction to the preceding facts. If the fluorine was present in the uncolored melt as sodium fluoride, there should be no reason why it should not remain as such on reheating. I think, rather, that one should see in this a precipitation brought about by the mobility of the molecules under the temperature conditions. The precipitation which was hindered by the viscosity of the medium on cooling occurred freely on reheating, but when, on reheating, too high a temperature was obtained, then the precipitate was redissolved.

Further, opacification is a phenomenon the operation of which can be followed. I have observed, and others have noted the fact as well, that certain fluor-containing glasses

*Read at the joint session in Paris of the Society of Glass Technology and the Société des Ingenieurs Civils, July 2nd, 1923. Published in the December, 1923, issue of the *Journal of the Society of Glass Technology*.

†National Sèvres Porcelain Factory, Paris.

[1] *J. Soc. Chem. Ind.*, 1915, 34, 402.

when thoroughly melted are perfectly transparent. If one gathers a drop of this glass while molten, one may observe the glass congealing while still transparent. Then, as cooling proceeds, the opacification is suddenly produced. *The phenomenon takes place in a mass which is already solid.*

Opacification is not produced in ceramics by the same means, as a rule; the fluoride glazes are capricious enough in their results. It is probable that the duration of firing in a medium containing water vapor is of great importance; there is a loss of fluorine, as is shown by analysis. Then one has recourse to such materials as the oxides of the MO_2 type, particularly SnO_2. The anhydride, arsenious oxide, has been indicated as an exception.

It is difficult in glasses such as those of which the glazes are constituted to produce opacification by reheating, probably on account of the quantities brought into operation, but in boric acid and aluminous glasses, of which certain glazes are constituted, and the basis of which is silica, feldspar, chalk and boric acid, one may not be faced with considerations as complicated as in those glasses containing fluorspar or cryolite. There is a deposit of *something* in the glass, because the opacifying medium cannot remain in solution.

If we pass now to the colored glasses we shall find analogous phenomena.

I shall restrict myself to those glasses colored by the oxides of cobalt, of copper, and of manganese.

A cobalt glass is blue, a copper glass may be blue or green, and manganese will color the glass grey-rose. I would note that the anhydrous salts of cobalt are blue, and that the hydrated salts and solutions are red. The cobalt glass has then the color of its anhydrous salts. The colors of the copper and manganese glasses are those of the salts of copper and manganese.

To me, in cobalt glasses the cobalt is without doubt in combination. In porcelain ware, it exists in the same state. In stating opinions which concern the other glasses, however, I think one ought to be very careful. Copper glasses show a tendency to deposit the metallic copper. Indeed, I have had occasion to observe in the preparation of a large number of glasses of this order that on the sides of the pot there were deposits of the metal. One may suggest, by way of explanation, the reducing actions occurring during fusion, but this explanation is insufficient. On pouring the molten glass into a copper ingot mold one can observe that where, in contact with the metal, a rapid cooling takes place there is a deposition of copper. The same thing applies to the pincers when they are used for drawing out the glass. All these facts would seem to indicate that the glass contains metallic copper in solution. The copper would be transformed from the cupric to the cuprous oxide at high temperatures. During the cooling stages, the cuprous oxide would be retransformed to the cupric state with deposition of copper, which is precipitated throughout the mass.[2] The coloration of copper ruby glasses is the exaggeration of this phenomenon. In the copper rubies obtained in the ceramic industry, the chemical process would be of the same order, and the reducing conditions which are believed indispensable to the formation of copper reds would have no other object than that of preventing oxidation from taking place; and, further, in copper ruby melts, when the reducing conditions have been exaggerated, instead of getting fine ruby tints, chocolate shades of an unpleasing nature are obtained. So far as manganese is concerned, phenomena are to be observed which do not accord with the general acceptation of a manganese silicate. On substituting oxide of manganese in the proportion of 0.1 molecule for 0.1 molecule of lime in the composition of an ordinary glass, I obtained a glass which was barely colored; on reheating, this glass became brown in color. This fact is not surprising. The type of ware known as "écaille" of the Sèvres porcelain is obtained by this process. The dish is fired in the furnace and is then reheated in a muffle, where it takes on its tortoise-shell color. The oxide of manganese behaves as if it were free. On addition to the preceding batch of a body which could act as a reducing agent, the glass obtained is only slightly colored, and the color does not appear on reheating.

Turning now to the glasses colored by selenium and by cadmium sulphide, I find phenomena of the same order, phenomena which can only be explained by the conception of glasses as being almost always solvents.

Some samples of selenium and sulphide of cadmium glasses are normal, the others present anomalies. A blue sample may give orange tints when reheated in the same way as the others, due to a poor melt having produced a size of particle incompatible with the normal coloration. These samples, which have the appearance of agate, are the result of successive reheating treatments during the manufacture of the sample.

One could multiply the instances wherein the reheating produced modifications of color in the greater number of glasses, results which are without explanation from a purely chemical point of view.

As a result of all this, I think I have demonstrated that the old purely chemical conceptions which have been applied to glass and to glazes are totally insufficient; their retention as theories of primary importance cannot but hinder the discovery of the key to the transformations which take place. I think that some of the facts are a little disconcerting to the eyes of a chemist of the old school, but they demonstrate the necessity of looking upon all phenomena in the light of modern science. One must accept the idea of a solution in many of those cases wherein one formerly allowed the intervention of a compound, the actual existence of which was doubtful from the observed facts.

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[2] $2CuO \rightarrow Cu_2O + O$ at high temperatures,
$Cu_2O \rightarrow CuO + Cu$ on cooling.—TRANSLATOR.

New Book

The Chemistry and Physics of Clays and Other Ceramic Materials by Alfred B. Searle, consulting ceramic chemist and technologist. Crown 4to., 634 pp., 52 illustrations. Price 55 shillings net. Published by Ernest Benn, Limited, 8 Bowerie street, London, E. C. 4, England.

Mr. Searle's book deals with the recent developments in ceramic research, and includes much information on the colloidal nature of clay, as well as detailed descriptions of the chemical and physical properties of the materials both in the raw and finished states, and of the application thereto of the great fundamental laws of physics and chemistry. It will thus be a valuable work of reference for that rapidly increasing class of physicists and chemists and engineers who are finding their vocation in the control of the manufacture and in the improvement of the quality of ceramic articles.

The Estimation of Selenium in Glass*

By A. Cousen, B.Sc., A.R.C.S., A.I.C.†

In the course of a detailed study of the use of selenium as a decolorizing agent in glass, it was found desirable to estimate, if possible, the amount of selenium actually remaining in the glass. It will be seen that the problem is fraught with no little difficulty, since the amount of the element used for this purpose is exceedingly small. Thus, for instance, the proportion of selenium in the glass batch used for melting colorless glass in tank furnaces usually approximates to half an ounce to each 1,000 pounds of sand, which would result in a glass containing about 0.0024 per cent of the element, providing that no losses occurred. That all the selenium remains in the glass is a most improbable contingency, since selenium is a somewhat volatile substance, having a boiling point, at atmospheric pressure, of 680 deg. It is evident, then, that the amount to be estimated will be something less than 0.0024 gm. per 100 gm. of glass, and probably considerably less.

Although there are many good methods for the estimation of selenium when it occurs in the free state or in the form of its more common compounds, one method only has been described, and that but in outline, for the estimation of small amounts of selenium occurring in glass. It is the method worked out by Fränkel,[1] and was employed for the determination of the element in ruby glass, in which it actually remained to the extent of 0.02 per cent, or about ten times the proportion actually used for decolorizing purposes. The process involves four independent operations, namely, (1) the breaking down of the glass, (2) the separation of the selenium from the products of combustion, (3) the solution of the element in the form of selenious acid, and (4) the estimation of the amount of selenium in solution. For breaking down the glass, Fränkel used a hydrofluoric-sulphuric acid mixture in which the selenium dissolved as it was liberated, since it is soluble in the latter acid. After the removal of insoluble matter, precipitation of the selenium was accomplished by means of sulphurous acid, after which the element was presumably filtered off. No indication of the method of redissolving the selenium was given (the entire description contained very few details of procedure), but the process employed was presumably that of oxidizing with nitric acid, or aqua regia, or a mixture of hydrochloric acid and potassium chlorate. Finally, the selenious acid was estimated colorimetrically, after the method of Meyer and von Garn, by the addition of hydrochloric acid and potassium iodine to the solution, whereby selenium and iodine were quantitatively obtained according to the equation:

$$H_2SeO_3 + 4HI = Se + 2I_2 + 3H_2O.$$

In the ordinary way, the selenium so precipitated rapidly coagulates and forms a turbid solution, but by the addition of gum arabic this coagulation is so delayed that the liquid remains clear for some time, and the amount of selenium present may be estimated by matching the combined selennum-iodine color against that produced by a similarly-treated standard sodium selenite solution of approximately the same strength. This comparison Fränkel performed in a suitable colorimeter.

In attempting to employ the above method, several difficulties were encountered. In the first place, the separation of the selenium from the fluoride solution was found impracticable with the small amount of the element remaining in the glasses examined, a fact that will be more appreciated when it is stated that 10 gm. of the glass contained, in general, only about one-fifth of a milligram of selenium. It is evident that the simpler the process for separation the less likely is the loss to be, and the following modification of Fränkel's process was finally adopted. Ten gm. of finely powdered glass were carefully dissolved (in a platinum dish) in a mixture of 25 c.c. of concentrated hydrofluoric acid and 15 c.c. of water, the liquid being kept as cool as possible during the process, since continued heating results in the loss of appreciable amounts of selenium as fluoride. By this means, the liberated selenium remained in suspension, and it was allowed to stand for an hour or two in order to coagulate. The contents of the dish were then poured into 400 c.c. of boiling water, when all but the selenium dissolved. While the water was still hot the selenium was filtered off on to a thick pad of filter-paper pulp in a Gooch crucible attached to a filter-pump. In cases where it was suspected that some selenium from the glass might be dissolved as selenious acid, the original hydrofluoric acid solution of the glass was mixed with an equal bulk of hot concentrated hydrochloric acid and a current of sulphur dioxide passed.

The re-solution of the selenium was accomplished by dropping the paper pad into a beaker containing a mixture of 10 c.c. of water, 5 c.c. of hydrochloric acid, and not more than 3 or 4 c.c. of a very dilute solution of chlorine in water (of a strength approximately one-sixtieth normal). Despite the fact that the concentration of the chlorine was so small, it was only necessary to warm the liquid gently and to disintegrate the pulp with a glass rod in order to dissolve all the selenium from the pad.

A further difficulty in the process devised by Fränkel lies in removing chlorine from the solution of selenious acid. Chlorine itself liberates iodine from potassium iodide, and the presence of even traces of chlorine is sufficient to vitiate any results obtained. The usual method of removing chlorine from a selenious acid solution is by adding sodium chloride and then repeatedly evaporating the liquid to dryness on the steam-bath. A series of trials, using a very dilute solution of sodium selenite, proved that, however, carefully this evaporation was performed, it resulted in losses of selenium possibly carried away as the volatile chloride. These losses, although perhaps of smaller importance when larger quantities of selenium are to be estimated, are rel-

*Read at Sheffield Meeting of the Society of Glass Technology, October 17, 1923. Published in the December, 1923 issue of the *Journal*.

†Department of Glass Technology, The University of Sheffield.

[1] *Sprechsaal*, 1914, 47, 444.

atively great when the amount of the element used is of the order of less than a milligram, the whole of the selenium being lost when large amounts of chlorine are present, and no device was found by means of which such losses could be obviated.

It was then deemed advisable to attempt to estimate the selenium in the presence of chlorine, and since this could not be performed by the aid of potassium iodide, another precipitant was sought. One which proved very suitable was found in phenylhydrazine hydrochloride, which precipitated selenium slowly but completely from very dilute, cold solutions of selenious acid. The color of the solution was not appreciably affected by the presence of chlorine, provided that the latter occurred only in very small amounts. Addition of gum arabic prevented the selenium, so released, from being precipitated, and a clear yellow solution was obtained. At the end of fifteen minutes the depth of color had become constant and remained so over a considerable period of time. In order to test whether or not the depth of color could be used as a measure of the amount of selenium in the solution the method employed was as follows:

A very dilute solution of sodium selenite containing 0.1 gm. of Na_2SeO_3 per litre was prepared and measured from a burette in successively increasing amounts of half a cubic centimetre into a series of Nessler tubes of approximately the same size and color. To each tube was added 5 c.c. of hydrochloric acid, 1 c.c. of 5 per cent gum arabic solution, and, after the solution had been made to 50 c.c., 5 c.c. of a half per cent aqueous phenylhydrazine hydrochloride. The range of tints was found to vary regularly, and it was found possible, by taking a fresh Nessler tube containing an unknown amount of the standard solution of any value up to about 10 c.c., and treating it similarly to the standard tubes, to determine the amount of selenium present. The method was obviously correct to a half a cubic centimetre of the standard, that is, to 0.000023 gm., and matching was performed by moving the tube containing the unknown solution along the line of standard tubes until the one most nearly corresponding in color was obtained. It was this modification of the colorimetric process which was finally adopted.

As it was obviously impossible to obtain a glass containing a known amount of selenium in order to test the above method of estimation, synthetic mixtures of soda-lime glasses and pure selenium were at first employed. It was found, however, that even when the selenium was finely ground, it was still too coarse to be easily attacked by the dilute chlorine solution, whereas when precipitated from the glass its state of division is so fine that it allows of easy solution. A more comparable condition was obtained by measuring out a known amount of the standard sodium selenite solution into a platinum dish, adding hydrochloric acid, heating, and passing sulphur dioxide. To the precipitate of finely divided selenium in suspension were added 25 c.c. of hydrofluoric acid, and 10 gm. of a soda-lime glass which dissolved in the acid solution. The resultant liquid was washed into 400 c.c. of boiling water, and filtered on a pulp pad as before described. The selenium so separated was dissolved by the dilute chlorine solution, and the selenious acid solution freed from paper pulp by filtration. The filtrate and washings were collected in a Nessler tube, gum arabic was added and phenylhydrazine hydrochloride, the color being finally matched against that of a series of tubes containing the standard solution in half cubic centimetre steps.

The results obtained were, in general, somewhat low, probably due to minute traces of selenium escaping either filtration or attack by the chlorine. The values were, however, within less than 1 c.c. of the actual amounts used, and as a general rule the loss was about a half a cubic centimetre, or the equivalent of 0.000023 gm. of selenium. The following table illustrates the degree of accuracy obtained:

Standard Sol. Used in Test	Standard to Which Test Corresponded	Standard Sol. Used in Test	Standard to Which Test Corresponded
2 c.c.	1.5—2.0 c.c.	4 c.c.	3.5 c.c.
3 c.c.	2.0—2.5 c.c.	5 c.c.	4.5 c.c.
3 c.c.	2.5 c.c.	7 c.c.	6.5 c.c.
4 c.c.	3.5—4.0 c.c.	8 c.c.	7.5—8.0 c.c.

A commercial glass decolorized by selenium in amount sufficient to give 0.0025 per cent in the glass, provided no volatilization occurred, was analyzed by the above method. It was found necessary to use 20 gm. of the sample to obtain suitable readings, and two successive determinations each gave values of 2.5 c.c. of the standard selenite solution, corresponding with 0.00057 per cent of selenium in the glass, or only about a quarter of the amount originally employed.

DISCUSSION

PROF. W. E. S. TURNER expressed the thanks of the Society to Mr. Cousen for the concentrated purpose with which he had pursued the question of determining the amount of selenium in glass. Some of the members might remember that the necessity for this work had arisen out of a paper presented in connection with the decoloring of glass by selenium. He and Mr. Cousen felt that they must, in order to arrive at any satisfactory conclusions, try to find how much selenium was left in the glass after the melting had taken place. For some considerable time Mr. Cousen had been at work on a method of estimation, and its application had led to results which would throw some very interesting light on the behavior of selenium during glass-making. These results, however, would form a subject for future reference. In expressing their thanks to Mr. Cousen, Prof. Turner said members would scarcely realize the amount of time needed in order to arrive at what seemed so very simple a result.

MR. W. J. REES thought the method followed by the author certainly seemed one that would be extremely useful to the works chemist in determining the proportion of selenium present in glass. He asked if the author had at any time made any attempt to determine the presence of selenium, if the amount was very small, by a spectographic method. Some years ago, Pollock, working in Dublin, attempted to devise a quantitative method, using a quartz spectrograph, and showed that as the concentration of the particular element looked for decreased, certain lines in the spectrum disappeared and there was the possibility of arriving at a quantitative method on this basis. If work in that direction could be pursued, it was just possible that a much quicker method of determination than the ordinary chemical method might be brought about. The chemist, of course, always

liked to base his determinations on something he could see. A spectographic method, if accurate, would be very much quicker.

MR. J. H. DAVIDSON said he had spent quite a lot of time estimating the amount of selenium in glass, and he would like to say how very grateful he was to Mr. Cousen for the extraordinary perseverance he had shown in his investigations. He could understand what difficulties he must have had to face, and the paper struck him as being a good piece of work.

MR. J. R. CLARKE suggested a physical method of determining the amount of selenium, which, he said, was probably in a colloidal state. The conductivity of the selenium altered under the influence of light. It might, he thought, be possible to estimate the amount of selenium in glass without breaking up the latter, by determining its conductivity, both in the dark and also under the influence of light. The conductivity would probably be increased in proportion to the amount of selenium present and thus serve as a measure for determination.

MR. A. COUSEN, in replying, thanked those who had spoken for their appreciation of the work done. It had taken rather a long time, but he thought the result was quite worth the effort.

With regard to Mr. Rees's suggestion that a spectographic method might be used, they had had that in mind as a method of estimating selenium in glass, and it would be worth while comparing results by the two methods, but he doubted if the spectographic method would be more rapid. As a matter of fact, selenium could be estimated in glass chemically in a few hours. On the other hand, the spectographic method would involve the use of a costly and rare piece of apparatus, so that such a method could not be used in a general way. The method of conductivity, he thought, seemed possible, and it might be worth while also to compare the results obtained with actual chemical results. Such a method, however, would be likely to be largely affected by the other substances present, which in a chemical method were entirely removed.

MR. W. J. REES suggested that the spectographic method could be performed in about ten minutes.

A New 60-inch Telescope

From advance proofs of an article that will appear in the March number of *Mechanical Engineering*, describing a 60-inch reflecting telescope built recently for the Perkins Observatory of Ohio Wesleyan University, the following excerpts of interest to glassmakers, have been made:

TYPES OF TELESCOPES NOW USED

Of the two types of present-day telescopes the reflector is increasing in popularity and use for astronomical purposes, despite the remarkable record made in past years by its contemporary, the refractor.

Since the reflecting telescope is seldom used for other than astronomical work, a brief comparison of that type of instrument with the more familiar refracting type, of which the ordinary spy glass is an example, may be of interest. The optical principle used in both types of telescope may be stated as follows: An object glass, or objective, brings to a focus parallel rays of light and the image thereby produced on the focal plane is enlarged by a suitably located magnifying glass or eyepiece, the degree of enlargement being in the ratio of the focal length of the objective to that of the eyepiece.

In the refracting telescope the objective is a lens, through which the light passes, the quality of the image thus depending not only upon the curvature of the surfaces of the lens, but also upon the refractive and dispersive qualities of the glass itself, together with its freedom from internal strains and imperfections. The difficulty of obtaining a very large piece of glass of suitable quality for a lens is easily understood, but the fact that the lens must be comparatively thin to avoid loss of light and hence has a tendency to sag when in use and thus distort the image, is not so generally appreciated. This sagging is of course extremely slight but is optically objectionable; sufficiently so, in fact, to render the use of a lens larger than 40 inches in diameter a matter of doubtful feasibility for an equatorial-telescope. The refractor, however, has certain advantages and is well suited to visual work in connection with double stars and the surface details of planets.

In the reflecting telescope the objective is a mirror which reflects the incoming rays of light from its silvered concave surface of parabolic contour, thus bringing the rays to a focus without the color distortion or aberration that is inherent in the refracting type. There is, of course, a certain loss of light in reflection and the silvered surface must be renewed at intervals to keep the loss at a minimum. The quality of the glass used for a mirror is of somewhat less importance than that used for a lens, although there must be no surface imperfections nor internal strains in the mirror. It is practicable, therefore, to make reflecting telescopes of very great light-gathering power, and while a mirror 72 inches in diameter and one even larger have been made, it is probable that the ultimate limit of size has not yet been approached. The quantity of glass required for one of these large mirrors is such that the manufacture of a suitable glass disk is a matter of considerable difficulty. In the new instrument the mirror is slightly in excess of 60 inches in diameter, 9 inches thick at the edge, and has in its center a hole 8½ inches in diameter. Its weight is close to 2,700 pounds. Although massive in its proportions, and of a rigid material, such a mirror is very sensitive to inequalities in support, tending to sag between supports, which would result in a distorted image, but at the same time it must be mounted movably so as to align its optical axis with the axis of the telescope tube. These conflicting conditions require great care in designing the mirror supports. The mirror is also very sensitive to changes in temperature, expansion of the glass altering the contour or "figure" of the polished surface. For this reason care must be taken to protect the mirror from variations in temperature, keeping it as nearly as possible at the temperature of the air to which it will be exposed when in use.

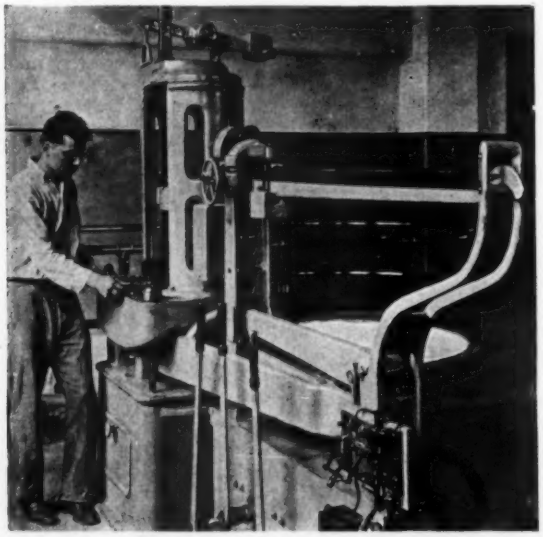
Smashing Dishes to Solve Their Secrets*

Various ways in which the Bureau of Standards smashes glass to learn its strength

By George H. Dacy

The crash and clatter of broken crockery and glassware resound nowadays in one of the national ceramic laboratories at Washington, where Uncle Sam is testing out all kinds of glass and chinaware for durability and service. A huge testing machinery that is capacitated to develop a pressure as great as 100,000 pounds is used as one of the agencies of glass destruction. This mammoth apparatus is employed to try out concentrations of force on the glass specimens.

All kinds of building glass, such as window glass, are



Powerful testing machine, capable of exerting a pressure of 100,000 pounds if necessary, is used in determining the strength of the strongest of glass.

being surveyed. A curious water pressure system is used to simulate the wind pressure which the western zephyrs often exert against the window panes. This experimental set-up also permits of securing data of great value to architects who sometimes have to plan and design aquariums and other structures made of glass, that are exposed to extremes of water pressure. The novel contrivance consists of a water-tight metal framework which is so devised that a sheet of window glass, flat side up and 43 by 46 inches in size, can be inserted between its top and bottom surfaces. There are special rubber guard rails that fit snugly against the edges of the glass and prevent any water from leaking away.

After the specimen of glass is in place, a small space about one-quarter of an inch in thickness is left directly above the glass. It terminates in a central glass tube which widens out into a funnel about 24 inches above the surface of the framework. A rubber hose from an adjoining water faucet provides a water supply which can trickle into the tube and fill the space above the glass. The water is allowed to run until its pressure is sufficient to break the sample of glass. A pane of glass three-sixteenths inch thick and 43 by 46 inches in surface dimension will break to pieces when the water in the tube attains a height of 14 inches. The glass will deflect one-half an inch before it breaks, so the Government tests have shown. A special recording gage is used to register the amount of deflection in each of the experiments. The action of the water and the pressure it exerts as the glass breaks, say when the water attains a height of 14 inches in the central tube, are the same as though the glass surface was covered with a solid sheet of water 14 inches high.

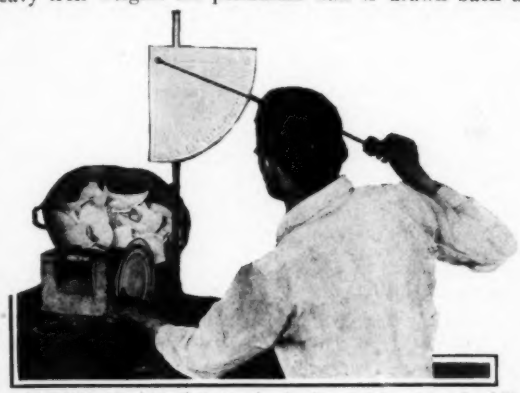
The amount of shot, deposited in the bucket before the glass specimen breaks, is the index of its transverse strength.

More than 5,000 samples of plate and window glass—special strips two inches wide and 16 inches long—have been crashed to pieces on two other devices. These devices are used in measuring the transverse and lateral strengths of the glass specimens. The first outfit is so arranged that the sample of glass is laid flat side uppermost, with the two ends of the glass supported and a saddle attached to a scale bar suspended over the unsupported center of the specimen. A shot bucket is attached to the free end of the scale bar and so adjusted that when the trigger is tripped, shot from an adjoining shot tower will stream into the bucket. The shot pours into the bucket, in each instance, until the weight on the scale bar is sufficient to break the glass. The instant that the glass breaks, the shot bucket falls on a lever and automatically stops the flow of shot. The amount of shot in the container is weighed, and this weight is the index to the transverse strength of the glass sample.

The arrangement of the other apparatus is such that the strip of test glass is laid against a weight flat side up. A metal ball attached to a pendulum arm is drawn back a certain distance and then released and allowed to catapult against the glass. The process is repeated until the glass breaks. There is a graduated scale installed along the path

*Scientific American, October, 1923.

of the pendulum so that the arc through which it swings can be measured each time the ball descends. The lateral strength of the glass specimens is ascertained in this way. The ball-and-pendulum scheme of destruction is also used in testing the durability of plates, cups and tumblers. In each case the piece of glassware or china is held against a heavy iron weight. the pendulum ball is drawn back and



Ball-and-pendulum method of destruction is also used in testing durability of plate, cups and tumblers.

then dropped so that it smashes against the article of crockery. The test is continued in each case until the dish or glass smashes into smithereens. The cups and glasses are always held against the weight in such a position that

Large panes of window glass, 43 by 46 inches, are tested on this apparatus in which water pressure is used to simulate wind pressure.

their bottoms are exposed to the blows of the swinging ball.

In testing the ability of different kinds of glassware and china to withstand regular and routine sterilization, the individual pieces are exposed for five successive periods in boiling water, and thereafter they are completely immersed in a closed vessel having a small steam vent, so as to be boiled continuously for six hours. In this novel way data are obtained which indicate how the different dishes will stand up in restaurant and hotel service where mechanical dish-washing machines are used. Study is also being made of the cobwebs of cracks which sometimes develop in china of inferior manufacture after it has been in use for a little while. The laboratory tests which have been made up to this writing indicate conclusively that made-in-America china and glassware are superior to the imported dishes and tumblers which heretofore have been purchased from French and German manufacturers in rather large quantities.

Society of Glass Technology

A meeting of the Society of Glass Technology was held in the College of Technology, Manchester, England, on Wednesday, January 16, 1924, the president, Prof. W. E. S. Turner, being in the chair. A paper by the president on "Specifications for Glass" formed the basis of an interesting discussion. J. H. Steele directed attention to a circular which he had received in which the use of glass for food containers was attacked. It was further stated that glass splinters were a possible cause of appendicitis and cancer. E. A. Coad-Pryor suggested the desirability of having some open preliminary specifications based upon durability alone. What was needed was some simple test which could be easily applied in the works. Fuller specifications could be made as experience accrued. Professor Turner in the course of his reply said that his attention had already been directed to the circular to which Mr. Steele referred. As the matter was one of some importance to the glass industry he had felt constrained to consult some of the leading pathological and surgical experts in this country and to obtain their views on the subject. The answers which he had received very definitely refuted the charge that glass splinters was a cause of either appendicitis or cancer.

The next paper considered was entitled, "The Production of Colorless Glass in Tank Furnaces, with Special Reference to the Use of Selenium," by A. Cousen, B.Sc., and Prof. W. E. S. Turner, D.Sc. Mr. Cousen summarized previous work done by the authors on this subject and gave the results of their latest experiments. Some types of commercial glass, including modern colorless glass jars, began to turn yellow when exposed for some time to light. This happened when stacks of jars were kept for a time in the open yards of glass factories. It was now shown that glasses which had been decolorized by selenium, together with arsenic, showed this yellowing effect on exposure to sunlight. On the other hand, glasses which were originally yellow, due to the presence of selenium without arsenic, became bleached by sunlight. It had previously been observed that the yellow selenium glasses when reheated to temperatures of 500 deg. to 600 deg. C became distinctly deeper in color, the maximum deepening being reached at a temperature of about 550 deg. When, however, a number of pink glasses such as are obtained by melting batches containing selenium along with arsenious oxide or sodium nitrate are reheated at the same temperatures, distinct loss of color occurs. This loss is slow at 525 deg., but is very appreciable even after an hour at 575 deg., the upper annealing temperature of the glass itself. Such a color change would be obtained in a lehr when the pink glasses were being annealed, and would call for careful regulation of the temperature during the process.

A meeting of the society held in Sheffield on Wednesday, February 20th, was devoted to a consideration of recent advances in pyrometry, with practical demonstrations.

The Glass Industry

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CLASSIFIED BUYERS' GUIDE, PAGE 18
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Readers of THE GLASS INDUSTRY in the United States and elsewhere are requested to favor the Editor with any information available from time to time concerning developments in their own or other fields which would be of general interest to the industry. Authoritative facts about new glass manufacturing projects, re-organizations, new factory construction, new processes and equipment, raw materials, manufacturing and market conditions, personal items, and other appropriate subjects would be welcomed.

Those experienced in the practical, technical or executive activities of glass manufacturing who are qualified and willing to lend their aid to the upbuilding and progress of the industry by giving from their store of knowledge to others, are invited to submit for publication articles on any subjects relating to glass which would be of interest and value to our readers. The authors of accepted articles of this kind will be compensated at usual rates.

Making Use of Statistics

Of the compiling of statistics there is no end, but the proper utilization of them is another story. Occasionally, however, industrial data are presented in such form that their practical value is obvious. Such an instance is found, we believe, in the forecast of new building construction for 1924 reprinted in this issue.

This forecast, based upon statistics of the building industry covering several years' operations and on opinions of men in close touch with conditions, can be used by manufacturers of all kinds of building glass and lighting and household glassware as a rough guide from which to plan production schedules and to estimate the potential sales possibilities in each geographical division of the country, as well as for other purposes. From the figures given in the forecast it is possible to establish sales quotas for district offices and agents, define areas for intensive selling effort, determine the number of salesmen necessary to cover given territories, fix appropriations for advertising, and determine the character of advertising copy appeal.

It can hardly be denied that estimates based on an extended and intelligent survey of conditions throughout the country are safer than the "guesses" commonly used by manufacturers as a basis for their manufacturing and marketing plans.

Technical Consultation Service

Question 55.—Relative value of limestone and burnt lime. In melting glass what difference is there in the cost of fuel consumed when limestone is used in the batch, compared with burnt lime?

Answer.—We give below a calculation of the amount of money saved if instead of a ton of limestone the equivalent amount of burnt lime is used.

The data are based on Richard's "Metallurgical Calculations." Since the metric system is used in that volume, the calculations are made accordingly and are only changed to the English system to obtain the final result.

Heat required to bring 1 kilogram of limestone to the dissociation temperature (825 deg. C):
$825 \times 0.33 =$ ..... 272.25 calories
Heat required to decompose 1 k.g. limestone ..... 415.50 calories

Total heat required per k.g. .... 723.75 calories

Heat required to bring the equivalent of 1 k.g. of limestone as burnt lime to 825 deg. C.:
$0.56 \times 825 \times 0.23 =$..... 106.26 calories
Saving per k.g. limestone:
$723.75 - 106.25 =$ ..... 617.49 calories
Saving per ton of limestone:
$2{,}000 \times 617.49 \times 1.8 =$ ..... 2,222,964 B.t.u.
Heat value of one ton of coal @ 14,000 B.t.u. = ... 28,000,000 B.t.u.
Saving per ton of limestone if the equivalent amount of burnt lime is used: (coal twelve dollars per ton)

$$\frac{2{,}222{,}964}{28{,}000{,}000} \times 12 = \$0.95$$

From the results obtained it would appear that the saving in fuel is insignificant. It is believed that increased output and quicker melting are more valuable "talking points" in favor of burnt lime than the saving in fuel.

We are well aware of the fact that the data on which these calculations are based contain many uncertain factors. For instance, the temperature at which limestone is dissociated is given as 825 degrees C. It is, of course, understood that the decomposition starts at a much lower temperature and the presence of other batch ingredients is certainly not without effect. The various specific heats at high temperature are obtained by calculation and are of course also open to doubt. —J. B. K.

Formulas for Computing Economies of Labor-Saving Equipment*

Report of the Materials Handling Division of the American Society of Mechanical Engineers.

The Materials Handling Division of the A. S. M. E. presents herewith formulas for computing the economies of labor-saving equipment. The Division quickly found in its work that it was desirable and necessary to have a standard method to yield results truly comparable, and therefore combined mathematics with economics to produce the desired result. While the formulas have been devised for the use of the Materials Handling Division, it is felt, however, that the fundamental economics as set up in mathematical form are applicable to most cases in which a difference in labor is obtained by the new method as compared with the old, whether it be a material-handling device, a machine tool, or a new process or method.

The whole problem is considered to be one of comparative costs. While it has been customary in the past to charge factory burden or factory overhead to the labor-saving devices, it has not been customary, however, to credit the labor-saving device for its portion of overhead saved, which generally is proportional to the difference in labor, since there is usually a definite relationship between labor and overhead.

In computing the costs, very frequently the labor to be saved has been classed as indirect or non-productive labor and as such is a part of the overhead or burden and should, therefore, not bear any superimposed charge from the other components of the overhead, as this would be pyramiding the charges; but where comparative costs of the economics are desired, then the indirect or non-productive labor should be charged with all the other component parts of the overhead with the exception of itself. In other words, the difference in labor as obtained by subtracting the labor used in the new saving method or device from the old method or device must be loaded with its proper share of the burden or overhead applied to both productive and non-productive labor in correct relative proportion.

Two common mistakes then have been made, rendering it difficult to secure proper comparative results and frequently obscuring the issue:

(1) The omission of burden or overhead charges on that portion of labor saved in comparing costs.

(2) The omission of burden charges on indirect labor in comparing costs, although they were added to the direct labor.

The following rule, therefore, for setting a value upon labor saved by an improved process has been evolved:

> Whatever valuation is arrived at in cost accounting as the cost per unit of labor used in production, also establishes the value per unit of labor saved by an improved process. For simplicity, no monetary value need be placed upon labor employed in comparative processes, except upon the amount of difference in labor required at the current rate paid plus "burden" or an equivalent.

Other items of cost should in like manner be accounted at the same rate as for similar items in making up the cost of product.

In calculating comparative cost, a new item is introduced which very likely becomes a factor in regular cost accounting and which the engineers and economists recognize, namely, the monetary value of increased production. Improved methods or devices will reduce the cost of making an article, since more are produced in a stated time, which is the same as reduction in one or more of the items of directly applicable cost. The rule is therefore:

> In a comparative accounting, increased production will always carry a higher value than that attached to normal production.

With the above consideration as a foundation, the formulas for calculating economics of labor-saving equipment are set forth herewith.

*From *Mechanical Engineering.*

Let:

Debit Items:
- A=percentage allowance on investment
- B=percentage allowance to provide for insurance, taxes, etc.
- C=percentage allowance to provide for upkeep
- D=percentage allowance to provide for depreciation and obsolescence
- E=yearly cost of power, supplies, and other items which are consumed, total in dollars

Credit Items:
- S=yearly saving in direct cost of labor in dollars
- T=yearly saving in fixed charges, operating charges or burden, in dollars
- U=yearly saving or earning through increased production, in dollars

- X=percentage of year during which equipment will be employed
- I=initial cost of mechanical equipment

Results:
- Z=maximum investment in dollars justified by the above consideration
- Y=yearly cost to maintain mechanical equipment ready for operation
- V=yearly profit from operation of mechanical equipment.

Then

$$Z=\frac{(S+T+U-E)X}{A+B+C+D} \quad \text{.....[1]}$$

$$Y=I(A+B+C+D) \quad \text{.....[2]}$$

and

$$V=[(S+T+U-E)X]-Y \quad \text{.....[3]}$$

Feeling that handling machinery, even if left idle a large part of the year, would probably require, under most conditions, approximately the same repair through deterioration as though in use, the Committee makes no deduction for such lack of use in the estimated cost of upkeep C. If greater accuracy be considered necessary, use C multiplied by X in place of C in the formulas.

APPLICATION OF THE FORMULAS

As an example of an application of the formulas, assume that the handling of miscellaneous materials about a factory which has formerly been done by four men receiving $3.50 per day each, or, allowing 300 days per year, at an annual direct cost of $4,200, can be done by one man operating an electric storage-battery industrial truck at a direct-labor cost of $1,050 per year, thus effecting a saving at the rate of $3,150 per year in direct-labor cost.

Assume also that through the greater promptness in moving materials and the more continuous operation of machines there is an increase in earnings, due to increased production, valued at $650 per year; also that the labor involved, being accounted as "non-productive," carries a fixed charge or burden of 10 per cent. In actual practice the plant operates 240 days per year or 80 per cent of the time. The various factors therefore, are estimated as follows:

A = 6 per cent	S = $3150
B = 4 per cent	T = 315
C = 20 per cent	U = 650
D = 25 per cent	X = 80 per cent
E = $450	

$$Z=\frac{(\$3150+\$315+\$650-\$450)\times 80}{55}=\$5331.$$

This indicates that equipment costing any sum below $5331 will earn some profit above interest on investment and maintenance.

Assume that an electric storage-battery industrial truck will meet the conditions stated and that its cost will be $2,200. Then the yearly cost to maintain equipment ready for operation, exclusive of labor, will be expressed by the formula, $Y = I\ (A + B + C + D)$ or $2,200 × 55 per cent = $1,210. Then the profit from operation of the mechanical equipment, according to [3], becomes ($3,150 + $315 + $650 − $450) × 0.80 − $1,210 = $1,722.

The profit V, or \$1,722, represents an annual earning upon the initial investment, over all items of cost, of over 78 per cent.

If, however, our example be applied to handling cargo at a railroad or marine terminal where the labor is productive labor and subject to all fixed charges as burden, an important difference in result will be had, indicating the importance of the factors T and U, and the necessity of placing proper values upon them if reliable results are to be had.

As such an example of an application of the formulas, assume that in handling miscellaneous cargo at a marine terminal, work which has formerly been done by four men receiving \$3.50 per day each, or, allowing 300 days per year, at an annual direct cost of \$4,200, can be done by one man operating an electric storage-battery industrial truck at a direct-labor cost of \$1,050 per year, thus effecting a saving of \$3,150 per year in direct-labor cost.

Since this labor is productive labor, it will bear its pro rata share of all fixed charges, estimated at 50 per cent and to be added to the direct-labor cost, representing a further saving of \$1,575 on account of labor. Also that, through the greater promptness in unloading and loading vessels, 5 per cent more ships can be accommodated, accounting for 15 days' extra use of the pier yearly. Assuming the investment in the pier to be \$1,000,000 and interest, taxes, etc., at 10 per cent, we have a credit item of 0.5 per cent to be divided, say, between 20 electric trucks, or \$250 per truck per annum.

Applying the formulas as in the previous example, we have

$$Z = \frac{(\$3150 + \$1575 + \$250 - \$450) \times 80}{55}$$

$$= \$6582 \text{ permissible investment.}$$

The yearly cost of operation is $Y = \$2{,}200 \times 0.55 = \$1{,}210$ as in the previous example. The profit above maintenance charges, V, will then be $(\$3{,}150 + \$1{,}575 + \$250 - \$450) \times 0.80 - \$1{,}210 = \$2{,}410$.

The profit \$2,410 represents an annual earning of nearly 110 per cent upon the investment in this case in place of 78 per cent in the previous example, all factors having been upon exactly the same basis except T (yearly saving in fixed charges) and U (yearly saving through increased production).

The following summary shows the relative value of the same device applied to two conditions, first, where the labor employed in the work is unproductive as regards producing an article of manufacture, and, second, where the labor used produces the salable commodity, in this case material handling.

	Case 1 Handling in Factory	Case 2 Handling in Marine Terminal
Cost of equipment	\$2200	\$2200
Z, investment justified	5331	6582
Y, yearly maintenance	1210	1210
V, profit from installation	1722	2410
Per cent return on investment	78	110

A study of this comparison indicates that with suitable values given to the factors the formulas proposed show not only the advantages obtainable under various conditions, but also that a device may be much more valuable per dollar invested in one industry than in another. The difference shown would have been much more pronounced had regular stevedores' wages been used for the wages of the man at the marine terminal.

Forecast of New Building Construction in 1924

The surprising accuracy of forecasts of building activity made at the beginning of each of the years 1922 and 1923 by *The Architectural Forum* gives special interest to their building survey and forecast for 1924, recently issued. This forecast represents not primarily their own opinion but the consensus of opinion of the architectural profession as expressed in facts and figures reported confidentially to them by 1668 architects from every section of the country. The following table gives *The Forum's* estimate based on these reports of the value of new building projects now being planned for the current year or under serious discussion between architects and clients.

In support of the accuracy of their forecasts *The Forum* points out that in January, 1923, they predicted that new building construction in 1923 would reach the value of \$5,116,544,000. At the end of 1923 it was reported by the Copper and Brass Research Association that the value of new building construction in the year had reached a total of \$5,922,900,000 which indicates that *The Forum's* estimate was within 15 per cent of the actual figures for the work done.

Naturally, during the current year, says *The Forum*, certain offsetting conditions may appear, such as the definite development of a buyer's strike, which will occur in the late Spring of 1924, if the great volume of building material orders are placed at that time and bring about a considerable increase in prices. If this condition actually develops, the figures for the latter half of 1924 will be smaller than anticipated. It is expected, unless prices go too high, there will be a late reaction in the Fall of 1924, providing during the year two peaks of building activity, totaling more than \$5,000,000,000.

Total Value of New Building in Forecast for 1924—\$5,560,367,700

Building Types	N. Eastern States	N. Atlantic States	S. Eastern States	St. Western States	Middle States	Western States	U. S. A.
Automotive	\$18,736,400	\$47,916,700	\$4,002,100	\$8,878,400	\$52,991,400	\$13,798,100	\$146,323,100
Banks	29,871,600	76,083,300	7,052,500	6,844,800	65,406,900	15,906,100	201,165,200
Apartments	33,445,900	198,849,500	18,333,400	22,183,600	170,214,800	125,822,800	568,850,000
Apartment Hotels	30,783,000	94,441,500	4,609,700	4,185,000	184,211,300	39,137,500	357,368,000
Clubs, Fraternal, etc.	22,955,500	68,528,600	13,826,000	20,711,100	148,896,100	38,929,800	313,847,100
Community, Memorial	3,022,500	25,472,700	1,553,100	8,484,700	20,797,900	22,471,900	81,802,800
Churches	21,461,300	74,982,800	15,338,800	26,861,500	103,763,200	46,766,600	289,174,200
Dwellings (under \$20,000)	17,471,600	99,677,400	8,463,000	16,169,600	60,477,900	24,992,200	227,251,700
" (\$20,000 to \$50,000)	11,736,600	46,655,000	5,359,900	9,650,300	31,610,700	9,176,000	114,188,500
" (over \$50,000)	8,726,500	29,549,200	1,953,000	7,021,500	17,558,400	10,750,800	75,559,400
Hotels	26,021,400	150,362,400	52,855,000	65,320,100	254,240,300	86,595,400	635,394,600
Hospitals	14,464,600	90,619,200	7,765,500	26,669,300	135,612,600	36,037,500	311,168,700
Industrial	35,008,300	157,941,900	10,567,900	10,645,400	165,633,000	36,316,500	416,113,000
Office Bldgs.	19,291,300	109,848,500	15,934,000	53,850,100	200,120,500	105,052,800	504,097,200
Public Bldgs.	9,827,000	20,537,500	6,060,500	24,700,800	60,747,600	25,271,200	147,144,600
Schools	77,937,100	203,325,900	43,285,300	44,038,600	334,831,000	98,840,400	802,258,300
Stores	7,554,700	34,552,600	3,828,500	4,901,100	68,094,600	21,262,900	140,194,400
Theaters	30,209,500	29,192,700	2,055,300	18,848,000	81,003,000	18,513,200	179,821,700
Welfare, Y. M. C. A., etc.	4,371,000	11,801,700	1,038,500	6,169,000	13,748,500	11,516,500	48,645,200
Total Value of New Buildings	\$422,895,800	\$1,570,339,100	\$223,882,000	\$386,132,900	\$2,169,959,700	\$787,158,200	\$5,560,367,700

Allocation by Percentage of Public Demand for New Buildings in 1924

Northeastern States	4.4	6.9	8.1	7.2	5.4	.7	5.1	4.2	2.7	2.6	6.1	3.4	8.2	4.5	2.3	18.4	1.8	7.	1.
North Atlantic States	3.1	4.9	12.7	6.3	4.4	1.6	4.8	6.3	3.	1.8	9.5	5.7	10.1	7.	1.3	12.9	2.1	1.8	.7
Southeastern States	1.8	3.2	8.2	2.1	6.1	.7	6.9	3.8	2.4	.9	23.6	3.4	4.7	7.1	2.7	19.1	1.8	1.	.5
Southwestern States	2.	1.8	6.	1.	6.	2.2	7.	4.2	2.5	1.9	15.9	6.9	2.8	13.1	6.4	11.4	1.3	6.9	1.7
Middle States	2.4	3.1	8.	8.6	6.8	.9	4.8	2.7	1.4	.8	11.8	6.2	7.7	9.2	2.8	15.4	3.1	3.7	.6
Western States	1.8	2.	16.	5.	4.9	2.8	5.9	3.2	1.2	1.3	11.	4.6	4.7	13.3	3.3	12.5	2.7	2.3	1.5
Nat'l Percentages, U.S.A.	2.6	3.7	9.8	5.	5.6	1.5	5.8	4.1	2.2	1.6	13.	5.	6.5	9.	3.1	15.	2.1	3.8	1.

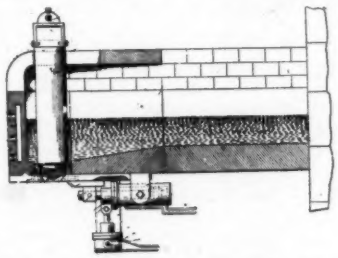
Recent Patents

NEW INVENTIONS DESIGNED TO IMPROVE GLASS AND THE MEANS OF PRODUCING IT

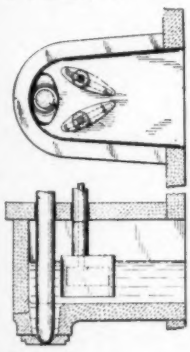
Copies of United States Patent Specifications may be obtained from the Commissioner of Patents, Washington, D. C. Price 10c each

Glass-Delivery Apparatus. U. S. 1,481,688. Jan. 22, 1924. John W. Carnahan, of Blackwell, Okla.

The inventor claims the combination with a glass furnace snout having a discharge opening in its bottom, of a base plate mounted upon the bottom, and having an opening coinciding with the opening in the snout, a vertically movable plug disposed within the snout and reduced at its lower end to fit said discharge opening and having a downwardly conical lower extremity, pressure operated means for raising and lowering the plug, a knife mounted upon the base plate for reciprocation across the axis of the discharge opening and against the base plate, and fluid operated means for shifting the knife in contact with the base plate and across the discharge opening to cut off the thread of glass depending from the conical extremity of the plug, then lowering the knife and retracting and raising it to its initial position.



Glass Feeder. U. S. 1,481,331. Jan. 22, 1924. Leonard D. Soubier, of Toledo, O., assignor to the Owens Bottle Company, of Toledo, O.



This invention is to provide adjustable guiding means for directing the flow of glass to and around the regulator, to meet varying conditions found in practice, such as variations in temperature, level of the glass, rate of discharge, etc.

The inventor claims the combination with a furnace, of a boot or extension thereon, said boot having an outlet orifice in its floor at the forward end of the boot, a regulator projecting downward into the glass over said outlet, a pair of wing guides projecting downward into the glass between said regulator and the furnace, means to laterally adjust said wings, and means to adjust said wings up and down in the glass.

Process of and Mixture for Making Glass. U. S. 1,482,389. Feb. 5, 1924. Alexander L. Duval d'Adrian, of Washington, Pa.

The object is to eliminate from glass the color caused by iron in the raw materials. In this method a novel chemical change takes place when the new glass-forming mixture is heated, and certain highly desirable results are obtained by the chemical action in the mixture. First, some of the iron, which may be in the form of free iron or combinations of iron, is oxidized and converted into higher iron oxides. The lower oxides of iron impart a decided greenish color to the glass, but this is not true of the higher oxides of iron. It is therefore an advantage to convert some of the iron into the higher iron oxides which do not materially color the glass. Second, some of the iron is converted into iron chlorides, which are very volatile and which are carried away from the glass mixture, in the form of vapors. These results may be accomplished by making the glass-forming mixture in the usual manner, and commingling therewith a chlorine compound such as a chlorine salt capable of acting as an oxidizing agent when the mixture is subjected to the high temperature at which it is melted. This "chlorine" salt is preferably calcium chloride, or some other chlorine combination, for example, chlorinated lime, ammonium chloride, potassium chlorate, or other salt.

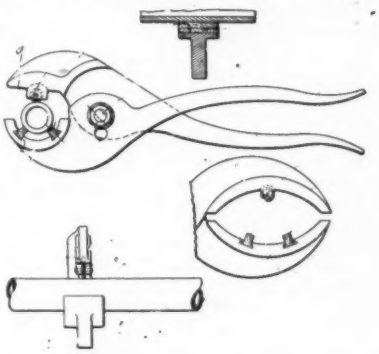
In a glass-forming mixture weighing about 1,600 pounds from one-half pound to 50 pounds, or more, of calcium chloride may be used, the exact amount depending upon the nature of the mixture and other conditions. An entirely satisfactory mixture may be made as follows:

Sand	1,000 lbs.
Soda ash	360 to 380 lbs.
Limestone	200 to 220 lbs.
Calcium chloride (chlorine salt)	2 to 6 lbs.

In addition to the above, some other decolorizer may be added if necessary or desirable; preferably a decolorizer such as manganese, selenium or its salts, nickel salts, etc., for the reason that these decolorizing agents result in actions quite different from the action of chlorine salt which serves as an oxidizing agent, as herein pointed out.

Glass Tube Cutter. U. S. 1,482,206. Jan. 29, 1924. Leroy L. Tuley, of Wood River, Ill.

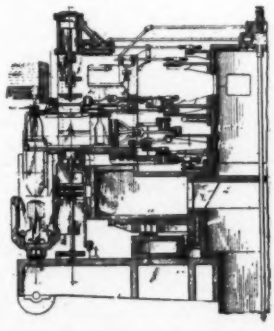
The device consists of a pair of pliers having one jaw adapted to engage the outer surface of the tube and the other jaw provided with a cutter which may be of the wheel type or a diamond point.



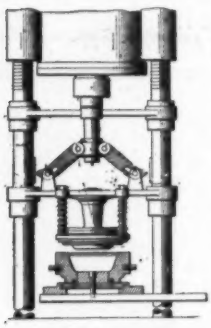
The inventor's claim is a glass tube cutter consisting of a pair of jaw members, means adjustably and pivotally connecting the jaw members, a glass cutter on one said jaw member and spaced, yielding abutments on the other jaw member.

Glass-Shaping Machine. U. S. 1,482,762. Feb. 5, 1924. Thomas C. Moorshead, of Alton, Ill.

An object of this invention is to provide a method and machine whereby a succession of molds may be filled from a stream of glass without interruption of the glass stream. Another object is to provide a method and apparatus for shaping a glass article, whereby a blank mold can be filled by a stream of glass and the blow hole formed by displacing action of the core, so as to forcibly shape the neck. Another object is to provide an entirely automatic glass shaping machine, whereby the molds, mounted on a traveling carrier, may be successively filled from a source of supply without interruption of the source of supply, and without interrupting the movement of the traveling frame. Other objects are to provide a novel form of cut-off mechanism, a novel finishing mold and novel mechanism for operating the same, a novel form of neck mold and operating mechanism therefor, a novel form of retainer for retaining the article when ejected, a novel form of ejecting mechanism. Also to construct a glass shaping machine, in which the parts are maintained cool by the circulation of air.



Glass-Pressing Mechanism. U. S. 1,482,263. Jan. 29, 1924. Jesse M. Said, of Corning, N. Y., assignor to Corning Glass Works, of Corning, N. Y.

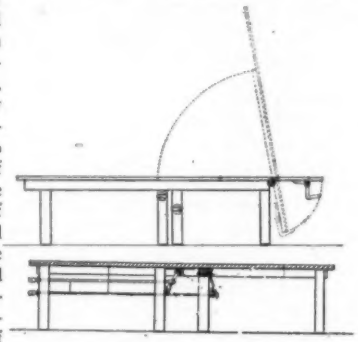


This invention is illustrated as applied to the glass press shown in U. S. patent No. 1,171,928, issued Feb. 15, 1916, to George E. Cleveland, but it will be understood that the same may be likewise applied to other glass working apparatus.

This invention comprises the use of levers which are connected to the end of the piston-rod of the fluid pressure cylinder of a glass pressing machine and to the plunger cross-head, so that increased pressure will be imparted to the plunger, as the piston-rod descends. In this manner novel means are provided for utilizing low fluid pressure to obtain sufficient plunger pressure so that better results are obtained in the finished articles.

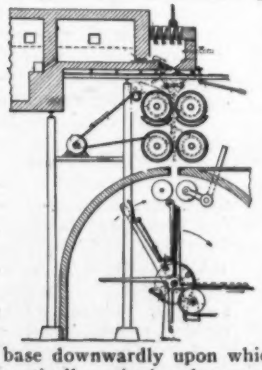
Glass-Cutting Table. U. S. 1,480,875. Jan. 15, 1924. Samuel John Bartlett, of Barry Dock, Wales.

This glass cutting table comprises in combination, a framework, a fixed part of the top secured to said framework, a movable part of the top pivotally mounted on said framework, an extension to said pivotally mounted part, brackets pivotally mounted to said extension and arranged to permit of a sheet of glass resting on same whilst the sheet of glass is positioned against the movable part of the table, and arranged to automatically move out of position when the sheet of glass lies flat on the table, means for automatically locking the pivoted part of the table against rebound when lowered into a flat position on the framework, and means for raising the pivoted part of the table around its pivot so as to sever the sheet of glass along the line of cut.



Glass Machine. U. S. 1,479,206. Jan. 1, 1924. George A. Shields, of Columbus, O.

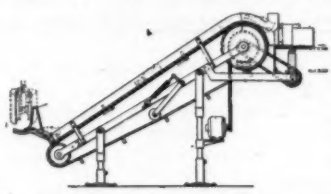
This invention relates particularly to a machine for rolling flat glass such as window glass, wire glass, florentine, rough rolled, factory, bordered, and other flat glass with or without surface designs or ornamentations.



Some of the inventor's claims are, in a glass machine, a transfer reel, a lever for holding and actuating the reel having latch controlled connection therewith at spaced points there around, and a brake carried and actuated by the said lever for controlling the reel during its said rotation between said points; a glass feeding device including a flowing chamber having an inclined base downwardly upon which the glass moves, and a pivoted vertically swinging door over the free edge of which the glass discharges downwardly from the chamber; a starting device consisting of a leading tube movable vertically beneath the discharge aperture, having a flexible pipe connected thereto whereby to permit of its vertical movement and the feed of cooling fluid to the tube; means for feeding molten glass in a sheet, and a cutting off device including a pair of swinging cutters between which the sheet of glass passes, having co-operating free edges, and a lever for actuating the cutters.

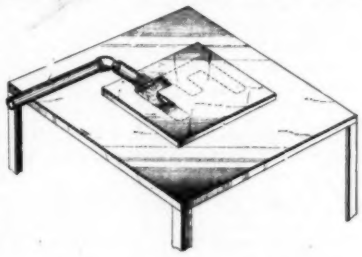
Conveyor in Glass-Making Apparatus. U. S. 1,480,063. Jan. 8, 1924. Clarence I. Hall and Alexander Samuelson, of Terre Haute, Ind., assignors to Chapman J. Root, of Terre Haute, Ind.

The inventors' claims include a conveyor for conveying glass bottles having a conveyor belt, a pair of pins projecting therefrom for engaging the neck of a bottle and conveying it with its axes extending longitudinally of the belt, a longitudinally extending plate at the discharge end of the conveyor belt for separating the bottle from the conveyor belt and the pins, a horizontal rotatable disk for receiving the discharged glass bottles a guard above the disk in the path of tilting movement of a bottle discharged to the disk from the apron, and a scraper disposed to intercept a bottle moving with the disk and to direct it therefrom onto another conveyor belt upon which said disk discharges the glass bottles.



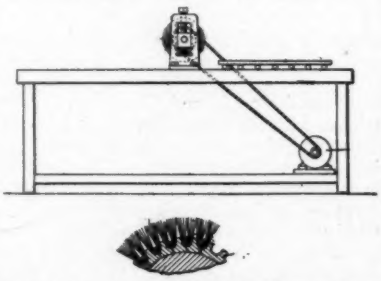
Method of Making Glass Letters. U. S. 1,482,789. Feb. 5, 1924. Eugene C. Gmelin, of Chicago, Ill.

A plate or die formed of cast iron or any other suitable material of appropriate dimensions is provided, having formed in its upper surface grooves or sunken portions delineating the letter or figure which it is desired to form in the glass. As here shown, the die or plate is formed with a letter "E." It is placed upon a suitable table or other support. A sheet of glass of appropriate dimensions is placed on the die so that the sunken portions are covered. The flame of the torch is directed downwardly onto the sheet of glass. The heat softens the glass until it is sufficiently yielding so that the pressure caused by the blast will force it completely down into the depressions in the dies causing it to conform to the surface of such depressions. Gravity assists the process.



Process of Polishing Glass. U. S. 1,480,542. January 15, 1924. Christopher Brown, of Charleroi, Pa., assignor to Pittsburgh Plate Glass Company.

This process is designed to reduce the power and labor costs and eliminate the necessity of securing the glass by cementing during the polishing operation. Also to produce a semi-polish such as that often applied to Carrara glass, which is uniform, but which is very much less than the polish produced by ordinary polishing methods.



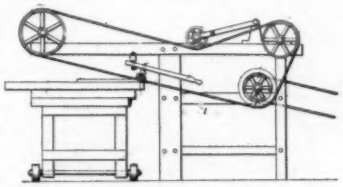
It has been attempted to secure this semi-polish by stopping the polishing operation before a complete polish is secured, but the polish so produced is not uniform over the entire sheet, and it is very difficult to secure the same polish on all sheets.

Another plan which has been tried was the use of wood polishing blocks on the ordinary grinding runners after the grinding was completed. This procedure gave a semi-polish, but it was also non-uniform. A third method involves what is known as the "burning" of the glass surface. This is accomplished by polishing in the usual way but using putty powder instead of rouge and running the polishers relatively

dry, thus securing a sort of burning or dulling effect, relieving the glass of its high polish. This process has been successful to a certain extent, but here again it is difficult or impossible to secure a uniform polish throughout the surface. The inventor claims that the present invention gives a uniform finish. It involves a process of smoothing or polishing a glass sheet which consists in rotating a brush with its axis extending transversely of the sheet and having radially extending fibers with the ends of such fibers in contact with the sheet at a rate of speed upwards of 500 feet per minute at the periphery of the brush, so that the fibers engage the sheet with an impact or whipping action, and in supplying an abrading or polishing material to make such action effective to smooth or polish the glass.

Machine for Smoothing and Polishing Bevels. U. S. 1,475,742. Nov. 27, 1923. Christopher Brown, of Charleroi, Pa., assignor to Pittsburgh Plate Glass Company.

This invention relates to a machine for smoothing and polishing bevels on the edges of sheets or blocks of material. The machine illustrated and described is employed for smoothing and polishing the bevels on carrara glass, but the invention is applicable to a wide range of material. In the use of the machine in connection with glass, the plates come to the machine with the bevels already ground roughly, and the function of the machine is to first smooth the bevels and then polish them. This is accomplished by two belts, one of which has an abrading surface to produce the so-called "smooth" and the second of which has a polishing surface and is used with rouge or other suitable polishing material to give the smoothed glass the necessary polish. The number of belts may be multiplied to suit requirements. Different bevels are taken care of by tilting the table which carries the glass plate between the belts and by manipulating the presser device back of the belt which forces the belt against the bevels.



Headlight Glass or Lens. U. S. 1,478,681. Dec. 25, 1923. Jacob Soderberg, of Pittsburgh, Pennsylvania, assignor to Pittsburgh Plate Glass Company.

The invention relates to headlight glasses or lenses for use upon vehicles and particularly upon automobile lamps. This invention has for its principal objects the provision of a lens in which the prism surfaces are of such a character that the mold for producing them may be made or refinished by machine work (rather than by hand chipping), thus producing mathematically accurate surfaces more cheaply and in a material such as stellite or nichrome, which is superior for glass casting or mold work and which otherwise could not be utilized because of the difficulty of working it.

Headlight Glass or Lens. U. S. 1,478,680. Dec. 25, 1923. Jacob Soderberg, of Pittsburgh, Pennsylvania, assignor to Pittsburgh Plate Glass Company.

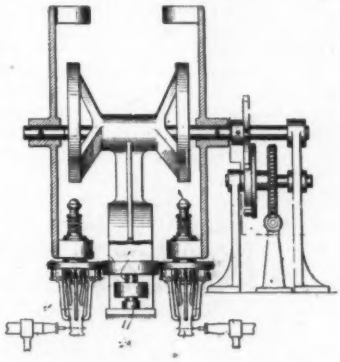
The invention relates to cover or headlight glasses or lenses of the type shown in the inventor's copending application Serial No. 443,362, of even date herewith, being particularly designed for automobile lamps. The present lens constitutes a modification of that shown in said application and differs therefrom in that the refracting prisms are in part placed upon one side of the glass and in part upon the other side, instead of having all of the refracting elements on the one side. The principle or theory of light distribution upon which the two lenses are constructed is similar and the result secured substantially the same.

Art of Uniting Glass and Celluloid. U. S. 1,478,862. Dec. 25, 1923. Harry Rosenthal, of New York, N. Y.

The inventor claims the art of uniting glass and celluloid which consists in coating a surface of a piece of glass with glue, permitting the glue coating to dry, softening the exposed surface of the coating with a glue solvent, softening a surface of a piece of celluloid by coating it with a liquid which is not a solvent for the glue or the celluloid but which will effect a softening of the latter, pressing the softened surfaces of the glass and celluloid together, and sealing the edges of the assembled parts by dipping them in hot paraffine.

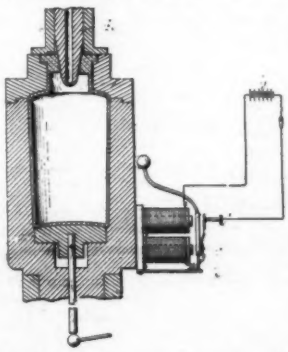
Apparatus for Severing Vitreous Articles. U. S. 1,482,272. Jan. 29, 1924. Francis W. Smith, of Cranford, N. J., assignor to Corning Glass Works, of Corning, N. Y.

The inventor claims a machine for receiving vitreous articles from a blowing apparatus and for removing the moil therefrom, said machine comprising in combination, a rotatable carriage in a substantially vertical plane provided with means for receiving and holding the articles as they are released from the blowing apparatus, means for rotating said carriage whereby to bring the article into inverted position, means for removing the moil from the articles held upon said carriage while in substantially inverted position, and means controlled by the movement of said carriage for releasing the articles after the moil-removing operation has been performed.



Method of Molding Glassware. U. S. 1,482,760. Feb. 5, 1924. John A. Milliken, of Bayonne, N. J., assignor to John E. Marsden, of Philadelphia, Pa.

The inventor claims that by vibrating the mold, as by applying thereto taps or blows in rapid succession, the mold may be operated at higher temperature and may be continuously used without setting aside for cooling, either natural or forced; and in general, by so vibrating or tapping the mold adhesion of the glass is prevented and there is obviated the necessity for control or regulation of its temperature. Besides making possible the utilization of a mold as rapidly as it can be filled and emptied in the production of a succession of glass articles, the vibration or tapping of the mold has a further advantage in that at the higher temperature at which the mold is worked the article at its mold-engaging surfaces is less streaked and of higher finish or polish.



A Dutch company has obtained a Dutch patent (No. 542,920) for a process and apparatus for drawing glass tube and rod. The process consists in introducing the glass into the inner surface of a hollow body placed preferably in an inclined position, and to which a rotary movement is imparted round its longitudinal axis, while the glass introduced is drawn by suitable means either by hand or by machinery. The apparatus for the application of this process is characterized by the fact that: (a) A device for regulating the temperature of the glass is placed inside or around a hollow body rotating on its longitudinal axis; (b) in the extension of the hollow body there is arranged a cylindrical jacket provided advantageously with a heating device; and (c) the outlet aperture of the hollow body is of conic shape. The same company has also obtained a second patent (No. 542,921) for a new glass working plant. It is characterized by the fact that the parts of the plant coming in contact with the liquid glass are composed of a metal, or metal alloy, insoluble in glass and protecting the metallic material against attack by the glass.—*Pottery Gazette & Glass Trade Review.*

The Glass World and What It Is Doing

News of the Industry

Hazel-Atlas Annual Report

At the annual meeting of the stockholders of the Hazel-Atlas Glass Company held at Wheeling, W. Va., on February 26, the annual financial report audited by Ernst & Ernst, certified public accountants, was submitted and the old board of directors was re-elected as follows: J. D. Biggers, W. H. Boshart, J. C. Brady, D. A. Burt, G. W. Hannan, J. J. Holloway, C. R. Hubbard, G. G. Oliver and C. A. Robinson. An amendment to the by-laws was adopted increasing the number of vice-presidents of the Company from three to five.

President J. C. Brady in his annual report told the stockholders that various difficulties had combined to make the year an unsatisfactory one, in spite of the fact that the first half of the year was the most profitable six months in the history of the parent company, the net earnings of that period being in excess of $900,000. Increased costs of labor and commodities could not be covered by increasing prices because of output being subject to contracts with customers. Serious difficulties in production were met with when tanks at Clarksburg and Hazel No. 1 factories gave out. Lacking full production facilities, sales fell from $9,003,599 during the first six months of the year to $6,680,848 for the last half of the year. The fruit jar business, the mainstay of the Atlas and Blackwell factories, while abnormally good during the first six months, dwindled to almost nothing from July 1. This plant will resume operations with the expected opening of the fruit jar market, almost any day.

Delays due to the necessity of rebuilding a furnace occurred at the new Zanesville plant and it is just now going into full operation. Hazel No. 1 plant is reported practically in full operation and Hazel No. 2 now running on a 75 per cent basis with a good prospect of beginning full operations in May. The Clarksburg plant is running full and the Grafton plant, after furnace repairs, will be ready for full operation about March 15. Machinery and molds for a variety of ware have been installed at the Blackwell plant, which hereafter will not confine itself to fruit jars alone but will operate continuously and therefore more profitably.

At Hazel No. 2 plant, Mr. Brady stated, a new development will soon be completed, which is expected to considerably reduce the fuel cost at all three of the Washington plants. This plant is constructed by the Combustion Utilities Corporation, with complete protection to the Hazel-Atlas Glass company's interests. Its success in Washington will be followed by installations at other plants.

Balance Sheet

Hazel-Atlas Glass Co., Wheeling, W. Va., and Subsidiaries at the close of business December 29, 1923.

Assets

Current cash—			
On hand	$9,160.00		
On deposit	735,947.85—	$745,107.85	
Trade acceptances—			
Customers		58,370.17	
Notes receivable—			
Customers	$46,233.18		
Accrued interest	252.02—	46,485.20	
Accounts receivable—			
Customers	$1,196,347.44		
Less allowance for doubtful, etc.	77,523.05		
	$1,118,814.39		
Creditors' debit balances	3,687.47		
Royalties	7,180.37—	1,129,682.23	
Inventory—			
Raw materials, in process and finished merchandise	$4,207,177.92		
Consigned merchandise	$643,520.94		
Less allowance for doubtful, etc.	77,533.05		
	$568,520.94		
Materials in transit	15,866.53		
Fuel oil storage	117,992.99—	4,909,558.38—	$6,889,203.83
Other assets—			
Miscellaneous accounts receivable, advances, etc.			142,021.70
Subscriptions to capital stock—			
Subscribed—employes (16,053 shares at $30 per share)		$481,590.00	
Less payments and interest credits—net		121,189.58—	360,400.42
Securities owned—			
Stocks of other companies			910,096.00
Combustion Utilities Corporation—			
Cash advanced			460,000.00
Leased machinery (depreciated value)			70,076.68
Permanent—			
Timber lands		$40,973.87	
Coal lands	$49,414.52		
Less depletion	9,016.46—	40,398.06	
Coal leaseholds	112,385.45		
Less depletion	10,930.04—	101,455.41	
Gas, wells and leaseholds	229,989.19		
Less depletion	169,486.41—	60,502.78	
Other leaseholds		20,333.65	
Real estate, buildings, machinery, equipment, etc.	12,069,093.98		
Less depreciation	3,883,712.62—	8,185,381.36—	8,449,045.13
Patent and patent rights			225,600.00
Deferred—			
Unamortized bond discount prepaid insurance, taxes, expenses, etc.		$163,290.11	
Maintenance, repair, materials and supplies		291,068.32—	454,358.43
			$17,960,802.19

Liabilities

Current

Notes payable—			
For money borrowed through brokers		$1,700,000.00	
Accounts payable—			
For purchases, expenses, etc.	$475,552.49		
Unpaid payroll	98,374.06		
Unpaid commissions	19,672.54		
Customers' credit balances	8,606.59		
Unpaid royalties	2,696.80		
Bank overdraft	1,431.83—	606,334.31	
Dividend payable January 2, 1924		225,367.00	
First mortgage bonds due January 1, 1924		40,000.00	
Accrued—			
Interest on bonds	$27,230.00		
Taxes, state and county	12,548.37		
Leading expense	2,975.66—	42,754.03—	$2,614,455.34
First mortgage bonds, 6%—authorized		2,200,000.00	
Less unissued and retired		794,000.00—	1,406,000.00
Reserve—for est'd federal taxes and reserve for contingencies.			435,347.03
Nominal—			
Capital stock—			
Authorized	$15,000,000.00		
Less unissued	3,731,650.00		
	$11,268,350.00		
Subscribed	401,325.00—	11,669,675.00	
Surplus—balance December 29, 1923		1,835,324.82—	13,504,999.82
			$17,960,802.19

(Note A)—No provision has been made in this balance sheet for the inventory value or the company's liability for materials in transit at December 29, 1923, aggregating $115,254.57.

(Note B)—The assets and liabilities of the Hazel-Atlas Glass Company of Oklahoma are included in this balance sheet as of December 31, 1923.

(Note C)—The balance sheet is subject to any necessary adjustment upon determination of the final liability of the company for federal taxes.

(Note D)—This balance sheet is subject to the comments contained in our "Certificate," included in and made a part of this report.

CONSOLIDATED SURPLUS

Hazel-Atlas Glass Co., Wheeling W. Va., and subsidiaries, Dec. 29, 1923.

Balance December 31, 1922, as shown by audit report			$1,835,048.20
Addition			
Net profit for the period from Jan. 1, 1923, to Dec. 29, 1923: Hazel-Atlas Glass Co.	$1,018,140.87		
Subsidiary companies (exclusive of the Kearns-Gorsuch Bottle Co.) net losses	2,881.00		
Net loss of Kearns-Gorsuch Bottle Co., including extraordinary charges for year estimated at $176,475.72)	242,983.55		
	$245,864.55		
Net profit of consolidated companies		$772,276.32	
Premium on capital stock sold		87,645.00	
Adjustment of expenses applicable to prior years—net		26.30	
Cancelling 1922 federal tax provision of the Hazel-Atlas Glass Company of Oklahoma		5,900.00—	865,847.62
			$2,700,895.82
Less—dividends paid			865,571.00
Surplus Dec. 29, 1923, as shown by this report			$1,835,324.82

Plate Glass Production Breaks All Records

All records for plate glass production in the United States were shattered in 1923, according to figures made public by P. A. Hughes, secretary of the Plate Glass Manufacturers of America. The total production was 89,069,411 square feet.

During the fourth quarter of the year, ending with December 31, official figures show that American plate glass manufacturers produced 22,872,773 square feet, bringing the total for the year up to 89,069,441 square feet, the largest amount ever produced in the history of the plate glass industry, showing a gain of 12,391,234 square feet over 1922. During 1922 domestic manufacturers produced 76,678,207 square feet. The output in 1921 totaled 53,578,682 square feet. The percentage of gain in 1922 over 1921 was 43 per cent; the gain in 1923 over 1922 was 16 per cent, and the figures for 1923 show a gain of 67 per cent over 1921.

While various manufacturers had under way enlargements and new plants, none of this increased capacity was available during the year 1923. By dint of hard work, and utilizing every facility at hand, plate glass manufacturers were able to increase their output in excess of 12,000,000 square feet over 1922. Another factor that entered into the situation was the fact that very few repairs had to be made during the year, as most of the plants had been put in excellent shape late in 1922.

Plate glass imports during 1923 totaled 26,260,476 square feet, or an increase of 150 per cent over the previous year, valued at $16,046,803, or an increase of 200 per cent over 1922. Imports in 1922 were 10,797,073 square feet and were valued at $5,089,932. Exports of plate glass in 1923 totaled 1,981,767 square feet, valued at $843,792, compared with 2,875,223 square feet in 1922, with a value of $1,156,617.

These figures would indicate that during 1923 total domestic plate glass consumption reached the enormous figures of 113,348,150 square feet. To this should be added the output of the Highland Park plant of the Ford Motor Company, which produces 2,000,000 square feet per annum. This brings the total up to 115,348,150 square feet.

For the purpose of comparison the figures for 1921, 1922 and 1923 covering domestic production, imports, exports and total consumption are presented herewith:

Year	U. S. Production sq. ft.	Imports sq. ft.	Exports sq. ft.	U. S. Consumption sq. ft.
1923	89,069,441	26,260,476	1,981,767	113,348,450
1921	53,578,682	3,106,659	2,243,559	54,441,782
1922	76,678,207	10,797,073	2,619,208	84,856,072

Insurance Program at Corning

Two thousand seven hundred employees of the Corning Glass Works at Corning, N. Y., have been insured under a health and accident policy arranged between the company and the Metropolitan Life Insurance Company.

Under this form of policy, the expense is borne in part by the company and the balance by the employees themselves. The cost to the latter varies according to the amounts of weekly sickness benefits, which are graduated according to weekly wages in case of sickness or accident. Monthly payments by the employees range from five cents per month for girl employees whose benefits will be $5.00 a week, up to $1.90 a month for employees who receive $25.00 a week when temporarily disabled by ill health or accident.

This arrangement between the Corning company and the Metropolitan does not in any way affect the provisions made under the Workmen's Compensation Law. However, it was felt by the Corning officials that a system such as has been introduced would be preferable to any plan whereby the employees might be paid direct by the company, as it eliminated any suggestion of charity and avoided any "passing the hat" for those who had suffered misfortunes.

Previous to this action, the Corning company, some time ago purchased life insurance for its employees under the "group insurance" plan, the policies ranging from $500 to $1,000 according to the length of time which the employee had been with the company. The insurance thus purchased was a gift of the company to its workers in recognition of faithful co-operation and friendly relations. Under the terms of this form of insurance, benefits were provided, not only in the case of death, but in the event that a workman was totally and permanently disabled before reaching the age of sixty. As in the case of ordinary insurance which workers might have purchased as individuals, the employee had the opportunity to designate his beneficiary, and of changing the beneficiary if circumstances made such a change necessary. The "group insurance" made possible the insurance of some persons who would have been unable to obtain policies as individuals, by reason of age or other factors, as no medical examinations were required.

In connection with the insurance program, the employees of the Corning Glass Company have available for themselves the services of a trained nurse supplied by the Metropolitan, as well as an extensive publication service to help develop health and safety measures to their highest point of efficiency.

Glassmakers' Salt Cake from Arizona

An extensive commercial development, in the form of a plant of 400 tons capacity per day for quarrying, crushing, washing, drying and screening natural salt cake (thenardite, Na_2SO_4) from enormous deposits of that material near Clarkdale, Arizona, has reached the production state and the owners have announced that they are now ready to make steady deliveries to customers.

The complete extent of the deposit has never been accurately determined. It is said to be positively known that there are at least 30,000,000 tons of thenardite in sight and how much more there may be, it is impossbile to estimate until diamond drilling operations shall have explored the mineral at depth. In the meantime, it requires little figuring to determine that it will take many years to exhaust the available supply at the rate of 400 tons per day—a rate that the owners hope to double very shortly.

The same climatic conditions that have preserved this great surface deposit since it was laid down uncounted ages ago will make continuous operation possible—the plant can be run 365 days a year.

The thenardite or natural sodium sulphate assays approximately as follows:

Sodium sulphate	83.6 %
Sodium chloride	9.92 %
Insolubles (clay)	6.48 %
Total	100.00 %

The material is put through several crushing and washing operations which are said to remove the last traces of salt and insolubles and leave the salt cake ready for the market. The producers claim that it is superior to manufactured or by-product salt cake, contains no moisture, no free acid and no iron.

Western Chemicals Incorporated, Merchants National Bank Building, Los Angeles, Cal., developed and are in charge of the enterprise. Balfour-Guthrie & Company, Los Angeles, Cal., are sales agents.

Toledo Factory Plans Reported Changed

The filing of a suit in Common Pleas Court at Toledo, O., early in February by the De Vore Company against the Libbey-Owens Sheet Glass Company charging breach of contract, led to the belief that Libbey-Owens had abandoned its plans announced last year, for building at Toledo, a polished plate glass factory to cost several million dollars. The De Vore Company was working on the engineering plans when notified to cancel the contract it is said.

Later unverified reports stated that a plant on a much modified scale would be built for grinding and polishing plate glass, but that the glass itself would be produced at the Company's Charleston, W. Va., plant. Lack of an adequate gas supply in Toledo, such as is available in the West Virginia field is said to be responsible for the Libbey-Owens decision to discard its original plans.

A press report says that plans are being made by Lockwood, Greene & Company, engineers, of Boston, Mass., for a complete new plant for the grinding and polishing of plate glass for the Libbey-Owens Sheet Glass Company, Toledo, O., the plant to cost between $1,000,000 and $1,500,000.

Sand Rate Is Reduced

After several years of effort on the part of Fred M. Renshaw, traffic manager of the Cincinnati Chamber of Commerce and T. J. Laughlin, traffic manager of a large glass manufacturing plant, a reduction of 50 cents a ton in the rates on glass (silica) sand from Ottawa, Ill., to Cincinnati, was ordered by the Interstate Commerce Commission.

According to Mr. Renshaw the decision is of broad significance, since the commission not only prescribed the lower rates asked for, but ordered the carriers to make refunds on the basis of the difference between the rate ordered and the rates formerly prescribed, or 50 cents a ton, the old rate having been $2.90 a ton. Mr. Renshaw asserts that the new basis will cause a readjustment of the rates from Ottawa to other glass manufacturing points, resulting in a general reduction in tariffs.

Haugen Proposes New Legislation

A bill, H. R. 762, introduced into the House by Representative Haugen, of Iowa, who is known of old to glass manufacturers, was favorably reported on January 29 by the Committee on Agriculture. The bill proposes an amendment to the Food and Drug Act of June 30, 1906, prohibiting the sale of "slack filled packages" and provides that when made in such form or so filled as to be deceptive or misleading as to the quantity of product contained, such containers shall be held to be misbranded within the terms of the Act.

A bill, H. R. 6531, introduced into the House by Mr. Williams of Michigan, proposes to legalize the making of contracts between producers of any kind of trade-marked or branded merchandise and dealers, fixing the resale price of such merchandise. The bill was referred to the Committee on Interstate and Foreign Commerce.

Cheaper Power From Mercury Boiler

A special demonstration of a commercial installation of the Emmet mercury-steam boiler, the invention of William Le Roy Emmet of the General Electric Company, was given recently for representatives of the press at the Dutch Point plant of the Hartford Electric Light Company, Hartford, Conn. This new method, which is being given a thorough test as a part of the company's production equipment, is reported to have shown such satisfactory results as to cause predictions to be made that this type of boiler will cut coal bills in half and eventually supersede the standard types of steam boilers in all industries.

Patent Office Delays Reduced

Conditions in the Patent Office have noticeably improved during the past few months. On December 21, 1923, there were 65,010 applications awaiting action compared with 74,256 three months earlier. All applications for patents are now acted upon within nine months. Applications for trade marks and designs also receive attention much quicker than was the case a year ago.

New Use for Plate Glass

Basketball teams in the Western conference, it is reported, have adopted glass plates as standard for bouncing the ball off the backboard.

The backboards are three-quarters of an inch thick and in addition to providing a uniformly smooth backboard, the glass enables spectators who sit back of the basket to tell whether the shots have been successful or not.

Corning Glass Works Buys Bulb Plant

Local newspapers report that the Corning Glass Works, Corning, N. Y., has purchased from the National Lamp Works the bulb plant known as the Rhode Island Glass Division, at Central Falls, R. I., and will continue the manufacture of bulbs under the management of Dr. J. C. Hostetter who has already taken charge.

Verified News of Trade Activities

The Allegany Window Glass Company, Port Allegany, Pa., has increased its capital stock from $50,000 to $330,000.

J. O. Perry was elected treasurer of the Davies Glass & Manufacturing Company, Martins Ferry, O., at a recent meeting of the company.

A loan of $50,000 was subscribed recently by citizens of Alexandria, Ind., to enable the **Lippincott Glass Company** to continue operations in that city.

The Davies Glass & Manufacturing Company, Martins Ferry, O., recently elected a new treasurer, O. J. Perry, formerly treasurer of Belmont County, Ohio.

McPike Mirror Corporation, Newark, N. J., has been incorporated with authorized capital stock of $10,000, to make auto mirrors. Frank P. Padalino of Newark is interested.

M. B. Mirror Works, Inc., has been organized with a capital of $10,000 to manufacture mirrors, etc. The directors are: Max Belinky, Michael Belinky and Celia Belinky, 269 Marlborough road, Brooklyn, N. Y.

George M. Vankirk, manager of the Wheeling sales department of the Washington, Pa., plants of the Hazel-Atlas Glass Company, has been appointed Chicago representative of the company to succeed G. A. Popplebaum, who has retired.

The Enterprise Art Glass Works, Milwaukee, Wis., manufacturers of ornamental glass and dealers in mirrors and beveled plate glass, was recently incorporated with a capital stock of $50,000 by Carl F. Hartung and Oscar Kirchner.

The Lafayette Window Glass Company, Clarksburg, W. Va., John Caussain, president, has increased its capital stock from $150,000 to $250,000, and has announced the placing of contracts for an installation of four Hilton blowing machines.

The C. A. Borchert Company, 127 N. Centre street, Baltimore, Md., was recently organized to take over the firm of Clarence A. Borchert & Company, manufacturers of cut glassware. The company will install power equipment, cutting, and other machinery.

Edmondson Warrin, Inc., 43-45 West 13th street, New York, has been incorporated with a capital stock of $100,000. The Company, of which Edmondson Warrin is president and Gabriel Verneuil treasurer, will engage in the manufacture of decorated china and glassware.

A recent fire, which originated apparently from spontaneous combustion in the packing room of the **C. L. Flaccus Glass Company's** plant at Tarentum, Pa., did considerable damage but was confined principally to that department and manufacturing operations were not seriously interfered with.

The Three Rivers Glass Company, Three Rivers, Tex., again commenced operation the latter part of January after being closed down for about six months. The company at present manufactures milk bottles exclusively, but reports that later they may go into the manufacture of soft drink bottles.

At a meeting of the board of directors of the **Rockford Art Plate and Window Glass Company,** Rockford, Ill., held on January 9, John P. Wollstadt was re-elected president, Wyatt McGaffey vice-president, and Stella Haas secretary and treasurer. The directors include the above mentioned officers and V. F. Schnell, Jr., and Frank O. Larson.

Charging the **Armor Plate and Non-Shatterable Glass Corporation** with fradulent practices, Attorney General Sherman of New York has obtained an injunction, restraining the company and its president, Samuel Krantz, from selling capital stock. It is charged that shareholders were enticed to buy stock although the corporation never manufactured its product and that the corporation is hopelessly insolvent with a stock liability of $300,000, and insufficient assets to meet indebtedness. In another action concerning an attachment placed on the Company's property, W. C. Bull, an inventor, claims that for his patents for producing laminated glass and his services as a technical man and manager of the proposed plant, there is due him $18,280. He claims that nothing was done toward establishing a plant, but the stock selling part of the venture was undertaken with industry and energy.

The American Crystal Company, Waterbury, Conn., manufacturer of watch crystals, etc., is planning a 1-story addition, 90 x 185 feet to its plant on South Main street.

The Packer-Littlefield Glass Company, 1721 Sedgwick street, Chicago, Ill., has been incorporated with a capital of $40,000 to deal in glass, building materials, paints, etc. The incorporators are: D. R. Littlefield, Samuel Packer, Alfred Beck.

The Warsaw Glass Company, 7932 South Chicago avenue, Chicago, Ill., has been incorporated with a capital of $20,000 to deal in and manufacture glass and do a general contracting glazing business. The incorporators are: Louis Warsaw, Max Warsaw, David J. Gittelson.

The Citizens' Glass Company, a new concern composed largely of local business men of Barnesville, O., has leased from the present owner, Gibson Bradfield, the plant of the former Eastern Ohio Glass Company which was sold at a receiver's sale about a year ago.

R. B. Voitle, with his family, has moved to San Francisco, where he will represent the Jefferson Glass Company, Jefferson Lamp Company and Economy Tumbler Company. Mr. Voitle is the son of Charles E. Voitle, secretary of the National Association of Manufacturers of Pressed and Blown Glassware.

The Canadian Auto & Art Glass Company, Ltd., Montreal, Canada, has been capitalized at $100,000 to manufacture glass and glassware of all kinds. The principal incorporators are George F. Pese of Fuerth-Nuremberg, Germany, manufacturer; Gerald McTeigue, advocate; Charles F. Huston, accountant, and John Corcoran, engineer, all of Montreal.

The corporate name of the Bellrose Standard Silica Company, of Ottawa, Ill., has been changed to the **Standard Silica Company.** The general offices have been moved to 39 South La Salle Street, Chicago, Ill. Extensive improvements have been made at the Ottawa pits, a new washing process has been developed and installed and storage facilities greatly increased to enable the company to handle their business more efficiently and rapidly and to the greater advantage of their customers than formerly.

The Western Glass Company, Streator, Ill., is pushing construction work on its new plant in Bastanchury industrial section of Fullerton, Cal. It is reported that the plant will cost about $350,000 and will include a polishing and cutting shop, 200 x 200 ft.; casting shop, 80 x 140 ft.; lehr building, 40 x 170 ft.; furnace building, 80 x 82 ft.; tank building, 42 x 80 ft.; machine shop, 40 x 80 ft.; warehouse, 40 x 80 ft.; and administration building, 60 x 65 ft., all 1-story. The plant will be devoted to the production of rolled glass products.

At a recent meeting of the stockholders of the **Coshocton Glass Corporation,** Coshocton, O., the following directors were elected: H. A. Neff, Charles H. Dankworth, Jesse C. Landkrohn, Philip Ebeling, Ben L. Morris, C. D. Lamb, Arthur Neff and S. N. McKelvey, of Bellaire, and Frank F. Wallace, J. W. Thompson, W. D. Brendel and K. L. Almack, of Coshocton. Harry A. Neff was re-elected president; C. H. Dankworth, vice-president; J. C. Landkrohn, secretary-treasurer, and Philip Ebeling, factory manager. According to Mr. Landkrohn the company has had a continuous run on tumblers and nappies since starting and the company plans to install two more machines at the earliest possible moment.

F. E. McElfresh has resigned as general manager of the New Cumberland Glass Company, New Cumberland, W. Va. When Mr. McElfresh took charge of this company they were operating on lamp chimneys exclusively. Last August the plant was completely destroyed by fire but has since been rebuilt and equipped with two new day furnaces and other equipment for making various lines of crystal and colored glass, in addition to lamp chimneys. In the reconstruction of the plant an improved fuel oil system developed by Mr. McElfresh was installed. Electrically-driven pumps for delivering the oil from an underground storage tank to the furnaces are used and the air compressors serving the burners are electrically driven. The other equipment throughout the plant is also of modern type.

Coming Meetings

The Spring meeting of the **American Society of Mechanical Engineers** will be held at Cleveland, O., May 26 to 29.

The next meeting of the **Eastern Division of the National Glass Distributors' Association** will be held March 19, at 10 A. M. at the Hotel McAlpin, New York City.

The next annual meeting of the **National Ornamental Glass Manufacturers' Association** of the United States and Canada will be held at New York, June 24 to 26, 1924.

Society of Glass Technology, S. English, secretary, announces meetings as follows: March 19, Stourbridge; April 16, Sheffield (annual general meeting); May 21, London and June 18, Sheffield. Details of programs will be announced a week prior to each meeting.

Inquiries Received

For further information address THE GLASS INDUSTRY

179. (From France) Can you advise us where we can buy an automatic machine for making glass serum bulbs as shown full size on the blue print enclosed? (Feb. 2.)

180. We would like the names of concerns that can manufacture hollow glass balls, silvered or gilded on the inside, to be used for decorative purposes. The articles are desired in large quantities and for export. (Feb. 26.)

181. Where can I have glass novelties, such as automobiles, made? (Feb. 23.)

Stock Quotations

(Reported by Moore, Leonard & Lynch, Frick Building, Pittsburgh, Penna.)

PITTSBURGH STOCK EXCHANGE, FEBRUARY 27, 1924

	Bid	Ask	Last
American Window Glass Machine common.	93½	94	94
American Window Glass Machine pfd.	94½	..	94½
American Window Glass preferred.....	108	..	108¾
Pittsburgh Plate Glass	218	220	216
U. S. Glass	24	24⅞	24½

Glass stocks have been fairly active during the month on the Pittsburgh Stock Exchange, with a moderately good demand. Pittsburgh Plate Glass was active and strong between 215 and 220. American Window Glass Machine preferred was very strong at 94½, while the common stock of the same company was rather inactive. American Window Glass preferred went ex-dividend February 15, the semi-annual dividend of $3.50 being payable March 1st. U. S. Glass was fairly active, selling around 24 and 25. An issue of 11,692 additional shares of U. S. Glass was put on the market, the proceeds of which are to be used for cancellation of notes of indebtedness and for further modernization of plants.

WHEELING STOCK EXCHANGE, FEBRUARY 27, 1924.

	Bid	Ask	Last
Hazel-Atlas	32	34½	34½
Imperial Glass	..	90	90
Fostoria Glass	140	..	145
Central Glass	105	110	115

There has not been much interest in the glass stocks on the Wheeling Exchange this month, the steel and paper stocks attracting most of the attention. Prices are unchanged, except that Hazel-Atlas showed weakness after reports that earnings for last year were just about enough to cover dividend requirements.

TOLEDO STOCK EXCHANGE, FEBRUARY 27, 1924.

	Bid	Ask	Last
Owens Bottle Machine, common.....	43½	43¾	43⅝
Libbey-Owens Sheet Glass, common.....	96	99	98
Libbey-Owens Sheet Glass preferred.....	106	109	108

Standard Plate Glass Corporation common stock which sold at 25 when first listed in the Pittsburgh Stock Exchange in January had risen on February 28, to 37½. The preferred which sold on the Pittsburgh curb at 88 on January 31 was admitted to trading on the Exchange and sold on February 28 at 93.

Current Prices of Glass-Making Materials

Quotations furnished by various producers, manufacturers and dealers

February 27, 1924

		Carlots	Less Carlots
Aluminum hydrate ($Al(OH)_3$)	lb.	.05	.05½
Aluminum oxide (Al_2O_3)	lb.	.06½	.07
Antimony oxide (Sb_2O_3)	lb.	.07½	.08½
Arsenic trioxide (As_2O_3) (dense white), 99%	lb.	.12	.13
Barium carbonate ($BaCO_3$) (precipitated)	ton	70.00	85.00
Barium hydrate ($Ba(OH)_2$)	lb.	.05	.05½
Bone ash	lb.	.06½	.07
Borax ($Na_2B_4O_7 10H_2O$)	lb.	.05¼-.05¾	.05½-.06¼
Borax, fused ($Na_2B_4O_7$) any mesh	lb.	.19	.20
Boric acid (B_2O_3), fused	lb.	.35	.35
Cadmium Sulphide (CdS)—			
Red	lb.	..	1.60
Orange	lb.	..	1.65
Yellow	lb.	..	1.85
Chrome Oxide (Cr_2O_3)	lb.	.30-.34	.36
Cobalt Oxide (Co_2O_3)—			
In bbls.	lb.	..	2.10
In 10 lb. tins	lb.	..	2.20
Copper oxide—			
Red (Cu_2O)	lb.	..	.20
Black (CuO)	lb.	..	.25
Black prepared	lb.	..	.30
Cryolite (Na_3AlF_6)	lb.	..	.09⅛
Feldspar—			
100 mesh	ton	14.00-18.00	20.00
80 mesh	ton	15.00	18.00
40 mesh	ton	12.50	15.50
Ferrous oxide (FeO)	lb.	..	..
Fluorspar (CaF_2)—			
Powdered white, 95%	ton	40.00	50.00
Powdered white, 90%	ton	38.00	45.00
Hydrofluoric acid (HF) 60% (in lead carboys)	lb.	..	.13
Kaolin (f.o.b. mine)	ton	9.00	14.00
Lead Oxide (Pb_3O_4) (red lead)	lb.	.11¼	.11½
Litharge (PbO)	lb.	.11¾	.12
Lime—			
Hydrated ($Ca(OH)_2$) (in 50 lb. paper sacks)	ton	12.50	..
Burnt (CaO) ground, in bulk	ton	9.00	..
Burnt, ground, in paper sacks	ton	11.00	..
Burnt, ground, in 280 lb. bbls. per bbl.		2.15	2.30
Magnesium carbonate ($MgCO_3$)	lb.	..	.09
Manganese 85% (MnO_2)	lb.	.03¾	.04
Nickel oxide (Ni_2O_3), black, for nickel content	lb.	.32	.45
Nickel monoxide (NiO), green, for nickel content	lb.	.30	.50
Potassium carbonate—			
Calcined (K_2CO_3) 90%	lb.	.06½	.06¾
Hydrated (KOH) 90%	lb.	.06¾	.07¼
Potassium nitrate (KNO_3) (gran.)	lb.	.06½	.06¾
Potassium Permanganate ($KMnO_4$)	lb.	..	.15
Powdered blue	lb.	..	.26
Standard formula	lb.	..	.32
Salt cake, glassmakers (Na_2SO_4), f.o.b. works	ton	21.00-26.00	30.00-40.00
Selenium (Se)	lb.	..	2.20-2.35
Soda ash (Na_2CO_3) dense, 58%—			
f. o. b. works.			
Bulk, spot	Flat 100 lb.	1.40	..
Bulk, on contract	Flat 100 lb.	1.35	spot 1.40
In 400 lb. bbls., on contract	100 lb.	1.69	spot 1.74
In 300 lb. bags, on contract	100 lb.	1.38	spot 1.50
Spot orders .05 per 100 lbs. higher.			
Sodium nitrate ($NaNO_3$), refined (Gran.)	lb.	.04¼	.04½
Sodium selenite (Na_2SeO_3)	lb.	..	2.00-2.50
Sodium Fluosilicate (Na_2SiF_6)	lb.	.07	.07¾
Sulphur (S)—			
Flowers, in bbls.	Per 100 lb.	3.35	3.65-3.90
Flowers, in bags	Per 100 lb.	3.00	3.30-3.55
Flour, heavy, in bbls.	Per 100 lb.	2.50	2.80-3.05
Uranium oxide (UO_3), 100 lb lots	lb.	..	2.00-2.50
Zinc oxide (ZnO)	lb.	.08	.08¼

Monthly Summary of United States Foreign Commerce in Glass

Exports

Corrected to January 23, 1924	December 1922 Quantity	December 1922 Value	December 1923 Quantity	December 1923 Value	Twelve Months Ending December 1922 Quantity	Twelve Months Ending December 1922 Value	Twelve Months Ending December 1923 Quantity	Twelve Months Ending December 1923 Value
Glass and glass products (total)	.....	$879,307	.....	$836,957	.....	$8,650,517	.....	$10,963,769
Plate and window glass—								
Window glass, common, box 50 sq. ft.	1,696	11,048	10,080	35,440	32,333	176,267	50,682	256,243
Plate glass, unsilvered, sq. ft.	232,691	84,488	148,181	55,903	2,875,223	1,156,617	1,981,767	843,792
Other window and plate glass, n.e.s. lbs.	174,568	23,354	225,977	21,272	1,975,211	225,851	3,397,376	375,412
Glass containers (bottles, vials and jars) lbs.	5,610,723	285,877	4,502,481	236,216	43,538,075	2,359,546	73,025,439	3,503,671
Table glassware, plain lbs.	1,403,868	153,127	1,486,192	175,569	13,077,547	1,437,184	20,616,277	2,278,202
Table and other glassware, cut or engraved lbs.	79,293	31,528	96,531	19,038	498,538	189,585	612,001	215,345
Glass for lighting—								
Lamp chimneys and lantern globes lbs.	83,111	20,158	195,259	35,913	1,369,043	277,841	2,044,557	393,981
Globes and shades for lighting fixtures lbs.	145,450	45,746	140,530	32,078	1,566,635	440,997	1,638,827	468,114
Lamps and other illuminating devices, chiefly of glass lbs.	91,281	31,233	157,048	32,695	1,092,279	382,841	1,606,590	395,058
Chemical glassware lbs.	22,223	13,040	19,420	14,381	276,509	154,696	247,443	175,801
Electrical glassware, except for lighting lbs.	354,449	25,027	162,216	17,728	2,310,347	172,890	2,665,704	184,276
Other glassware, n.e.s. lbs.	765,614	154,681	1,263,998	160,724	12,506,101	1,676,202	10,868,527	1,873,874

Imports

Corrected to January 23, 1924	December 1922 Quantity	December 1922 Value	December 1923 Quantity	December 1923 Value	Twelve Months Ending December 1922 Quantity	Twelve Months Ending December 1922 Value	Twelve Months Ending December 1923 Quantity	Twelve Months Ending December 1923 Value
Glass (total)	.....	$1,404,613	.....	$2,021,616	.....	$13,892,239	.....	$24,897,785
Cylinder, crown, and sheet, lbs. dut.	.....	.....	.....	.....	[1]41,597,241	[1]2,085,182	.....	.....
Unpolished, lbs. dut.	3,350,243	170,747	3,483,816	191,793	[1]11,254,210	[2]497,476	46,660,671	2,120,191
Bent, ground, beveled, colored, painted, etc. and polished dut.	.....	71,502	.....	61,199	.....	[2]209,288	.....	791,788
Plate glass—								
Unsilvered, sq. ft. dut.	1,492,555	766,038	1,968,348	1,318,755	10,797,073	5,089,832	26,260,476	16,046,805
Fluted, rolled, etc., or silvered, or containing wire netting, sq. ft. dut.	147,320	17,454	225,891	36,617	[2]523,589	[2]94,904	2,196,813	374,276
Containers—bottles, vials, etc. dut.	.....	22,077	.....	13,000	.....	299,645	.....	198,367
Table and kitchen utensils, lbs. dut.	99,023	34,608	53,596	10,472	339,076	130,084	655,438	168,866
Glassware, cut or decorated, lbs. dut.	186,777	89,464	249,340	135,950	.....	2,033,135	3,578,575	1,475,310
Blown glassware, n. e. s., lbs. dut.	422,095	94,768	303,601	98,564	[2]1,483,247	[2]370,141	6,252,178	1,459,392
Other glassware { free	.....	.....	.....	.....	.....	[1]106,800	.....	.....
Other glassware { dut.	.....	137,955	.....	155,266	.....	2,975,752	.....	2,262,790

[1]Jan. 1 to Sept. 21, 1922. [2]Beginning Sept. 22, 1922.